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ABSTRACT

A comprehensive mathematics program for grade 2 is presented in 58 units. These units are organized around four central themes: (1) number and numeration; (2) operations with numbers; (3) geometry and measurement; and (4) graphs, problem solving, and probability. A spiral approach is used with various topics being indexed as to unit and page. Specific learning experiences are suggested for each unit. Suggested use of mathematical laboratory materials is found throughout. (MP)

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Mathematics

GRADE 2

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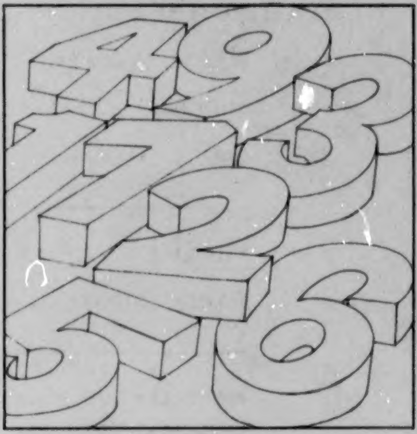

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FOREWORD

The Mathematics: Grade 2, Scope and Sequence Teaching Manual is one of a planned series of bulletins designed to extend, strengthen and refine the computational skills, mathematical understandings and problem solving abilities of all pupils involved in elementary mathematics.

This bulletin presents both the scope and the sequence of activities for implementing the New York City mathematics program at Level 2. Much consideration is given to the individual learning styles, the diverse mathematical needs and the unique rates of mastery of all our pupils; thus, the material was planned to assist teachers and supervisors to meet these needs.

The activities reflect current mathematical ideas and are designed to help teachers and pupils gain new insights into mathematical content. It is hoped Mathematics: Grade 2 will serve as a vehicle in providing a systematic and continuous mathematics program that is relevant, logical, useful, effective, and exciting for all New York City public school youngsters.

Arnold Webb
Executive Director

ACKNOWLEDGEMENTS

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The writers directly responsible for planning, designing, researching and preparing this bulletin are:

Jennie Berger, Mathematics Coordinator,
Community School District 16

Alice Lombardi, Mathematics Coordinator,
Community School District 24

Final editing, revision and preparation for publication was furnished by:

Mary J. Teshara, Mathematics Coordinator,
Community School District 12

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TABLE OF CONTENTS

Page

Introduction 1
Basic Mathematics Laboratory Equipment 2
Mathematical Understandings for Grade 2 4
Unit 1. Number-Numeration 6
Unit 2. Number-Numeration 10
Unit 3. Number-Ordinals 17
Unit 4. Geometry 21
Unit 5. Mathematical Sentences 25
Unit 6. Number-Numeration 28
Unit 7. Measurement: Money 33
Unit 8. Number: Graphs 38
Unit 9. Addition of Whole Numbers 40
Unit 10. Substraction of Whole Numbers 43
Unit 11. Measurement: Time: Calendar 47
Unit 12. Number: Ordinals 52
Unit 13. Addition of Whole Numbers 54
Unit 14. Subtraction of Whole Numbers 58
Unit 15. Geometry 61
Unit 16. Addition of Whole Numbers 63
Unit 17. Subtraction of Whole Numbers 67
Unit 18. Problem Solving 69
Unit 19. Number: Fractional Numbers 71
Unit 20. Measurement: Time: Clock 75
Unit 21. Addition and Subtraction of Whole Numbers 79
Unit 22. Number-Numeration 82
Unit 23. Measurement: Money 86
Unit 24. Addition and Subtraction of Whole Numbers 89
Unit 25. Addition of Whole Numbers 94
Unit 26. Addition of Whole Numbers 96
Unit 27. Subtraction of Whole Numbers 98
Unit 28. Subtraction of Whole Numbers 100
Unit 29. Measurement: Temperature: Cel., Fahr. 102
Unit 30. Number 104
Unit 31. Multiplication of Whole Numbers 107
Unit 32. Division of Whole Numbers 110
Unit 33. Measurement: Linear: Metric and Customary 114
Unit 34. Geometry: Symmetry 120
Unit 35. Number 122
Unit 36. Multiplication of Whole Numbers 123
Unit 37. Division of Whole Numbers 125
Unit 38. Number: Fractional Numbers 126
Unit 39. Measurement: Linear: Metric and Customary 129
Unit 40. Number-Numeration 131
Unit 41. Number-Numeration 133
Unit 42. Addition of Whole Numbers 135
Unit 43. Addition of Whole Numbers 138
Unit 44. Problem Solving 142

TABLE OF CONTENTS (continued)

Unit 45. Multiplication of Whole Numbers 144
Unit 46. Division of Whole Numbers 146
Unit 47. Number-Numeration: Roman Numerals 147
Unit 48. Measurement: Money 148
Unit 49. Subtraction of Whole Numbers 150
Unit 50. Measurement: Capacity: Metric and Customary 154
Unit 51. Multiplication of Whole Numbers 157
Unit 52. Division of Whole Numbers 161
Unit 53. Operations: Fractional Numbers 163
Unit 54. Measurement: Quantity 167
Unit 55. Multiplication of Whole Numbers 168
Unit 56. Measurement: Weight, (mass) Metric and Customary 170
Unit 57. Number-Numeration 174
Unit 58. Probability 176

CONTENTS BY TOPIC

Topic	Unit	Page
Number-Numeration	1	6
	2	10
Ordinals	3	17
	6	28
	8	38
Ordinals	12	52
Fractional Numbers	19	71
	22	82
	30	104
	35	122
Fractional Numbers	38	126
	40	131
	41	133
Roman Numerals	47	147
	57	174
Addition of Whole Numbers	9	40
	13	54
	16	63
	21	79
	24	89
	25	94
	26	96
	43	138
Subtraction of Whole Numbers	10	43
	14	58
	17	67
	21	79
	24	89
	27	98
	28	100
	49	150
Multiplication of Whole Numbers	31	107
	36	123
	45	144
	51	157
	55	168
Division of Whole Numbers	32	110
	37	125
	46	146
	52	161

CONTENTS BY TOPIC (continued)

Topic Unit Page

Fractional Numbers............................ 19 71
38 126
53 163

Measurement

Money 7 33
Time: Calendar 11 47
Time: Clock 20 75
Money 23 86
Temperature, Celsius and Fahrenheit 29 102
Linear, metric and customary 33 114
Linear, metric and customary 39 129
Money 48 148
Capacity, metric and customary 50 154
Quantity 54 167
Weight, metric and customary 56 170

Geometry 15 61
Symmetry 34 120

Problem Solving 18 69
44 142

Mathematical Sentences 5 25

Probability 58 176

INTRODUCTION

The Mathematics: Grade 2 Scope and Sequence Teaching Manual was prepared to assist teachers and supervisors in implementing the mathematics program for the grade.

The Scope of Mathematics for Grade 2 is presented in 58 units, each of which may require one or more lessons. These units are organized around four central themes and are coded as shown below:

*	Number; Numeration
**	Operations with Numbers
***	Geometry and Measurement
****	Graphs, Problem-solving and Probability

Mathematics: Grade 2 is presented in a spiral or cyclical arrangement for the following reasons:

- to provide for continuous development and reinforcement throughout the year
- to develop ideas gradually based on simpler aspects
- to show the interrelationships of ideas
- to review, maintain and extend skills

Specific learning experiences for children are suggested for each unit. The teacher may choose those activities which he considers most helpful for his particular class.

Suggested use of mathematical laboratory materials, usually available in schools, is found throughout this publication. However, no attempt is made to be prescriptive. Many teachers will substitute other materials or children-made materials.

In the spiral approach, you will find, for example, that Addition of Whole Numbers (Basic Facts) is treated in Units 9, 13, and 16 with many suggestions and approaches given for Unit 9. Units 13 and 16 refer to Unit 9 and also offer additional suggestions.

The suggestions in this publication are designed to help the teacher present a mathematics program which will be meaningful to the pupil, will help him think through mathematical relationships, and will enable him to achieve functional competency. In each school, the needs of the pupils should guide the teacher and supervisor in the adaptation of these materials.

Basic Mathematics Laboratory Equipment

Various manipulative materials are recommended for use in implementing the 58 units. To provide a brief overview of some specific mathematical concepts derived from these materials the following is presented.

Abacus

Counting; grouping; numeration; place value.

Attribute Blocks

Classification; set concepts; logic; number operations; patterns; polygon construction.

Beads on a lace and/or tens frame

Counting; estimation; basic number facts; number operations; graphs; patterns.

Calculators

Counting; place value; addition; subtraction; multiplication; division; mathematical sentences; principles of number operations; problem solving.

Colored Rods (Cuisenaire)

Classification; ordering; estimation; equalities; inequalities; mathematical sentences; counting; place value; odd and even numbers; patterns; addition, subtraction, multiplication, and division of whole numbers; basic number facts; fractions; metric system; polygons - construction, names and/or properties; symmetry; perimeter; area; graphs; construction of 3-D shapes.

Discs (plastic and/or paper)

Counting; estimation; basic number facts; number operations; fractions.

Geoboards

Point; line segment; parallel lines; intersecting lines; angles; polygons - construction, names and/or properties; area; perimeter.

Counting; number patterns ; multiplication; division, odd and even numbers; fractions.

Mathematical Balance

Counting; equalities; inequalities; mathematical sentences; basic number facts; number operations; operations with fractional numbers.

Multibase Arithmetic Blocks

Counting; estimation; place value; patterns; addition; subtraction; multiplication; division.

Pattern Blocks

Counting; estimation; patterns; addition; subtraction; fractions; linear measurement; polygons - construction, names and/or properties; symmetry.

Squared Materials

Counting; equalities; inequalities; mathematical sentences; numeration; patterns; place value; addition, subtraction, multiplication, and division algorithms; graphs; measurement.

Tangrams

Counting; fractions; polygons - construction, names and/or properties; symmetry.

Unifix Cubes or Interlocking Cubes

Ordering; counting; estimation; place value; groupings; patterns; mathematical sentences; basic number facts; addition; subtraction; multiplication; division; graphs.

To provide a brief overview of the mathematical understandings and skills for Grade 2, the following is presented:

Mathematical Understandings for Grade 2

1. Number; Numeration

   Count by twos, threes, fours, fives, tens
   Count by hundreds, tens and hundreds to 10 hundreds
   Understand place value and record in expanded notation to 100
   Round numbers to nearest ten

2. Addition of Whole Numbers

   Basic facts
   Algorithm: vertical format, two addends, sums through 99 with and without exchange
   Column addition: more than two addends, sums through 99
   Addition and subtraction as related operations
   Observe and use commutative and associative properties of addition

3. Subtraction of Whole Numbers

   Basic facts
   Algorithm: vertical format, regrouping 1 ten for 10 ones
   Find the missing addend in addition and subtraction sentences

4. Multiplication of Whole Numbers

   Basic facts: twos through 5 twos, threes through 5 threes, fours through 5 fours, fives through 5 fives
   Observe commutative property of multiplication

5. Division of Whole Numbers

   Basic facts: twos through the number of twos in 10, threes through the number of threes in 15, fours through the number of fours in 20, fives through the number of fives in 25

6. Fractional Numbers

   Concepts of one half and one fourth of a whole
   Concept of thirds of a whole
   Finding 1/2, 1/4, of a number of things
   Equivalence: fourths and halves

7. Geometry

   Concepts: point, line segment, ray, line
   Properties of geometric figures: rectangle, square, triangle, circle
   Recognition of the differences between symmetrical and asymmetrical patterns

8. Measurement

   Linear: foot, inch, half-inch, centimeter, meter
   Money: penny, nickel, dime, quarter, half-dollar, dollar
   Capacity: cup, pint, quart, liter
   Quantity: dozen, half-dozen
   Weight: ounce, pound, gram, kilogram
   Time: clock - half-hour
   calendar - number of months in year

Temperature: non-standard units of measure; Fahrenheit and Celsius scales

9. Other Content Included

Graphs, Problem solving and Probability

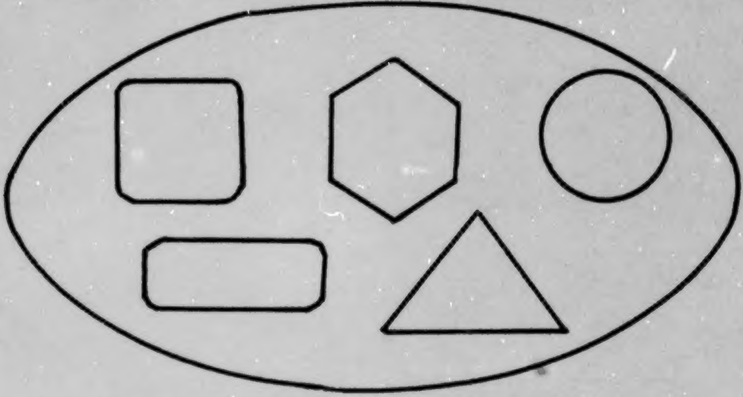
*

UNIT 1. NUMBER -NUMERATION

Use set ideas to reinforce and extend number concepts.

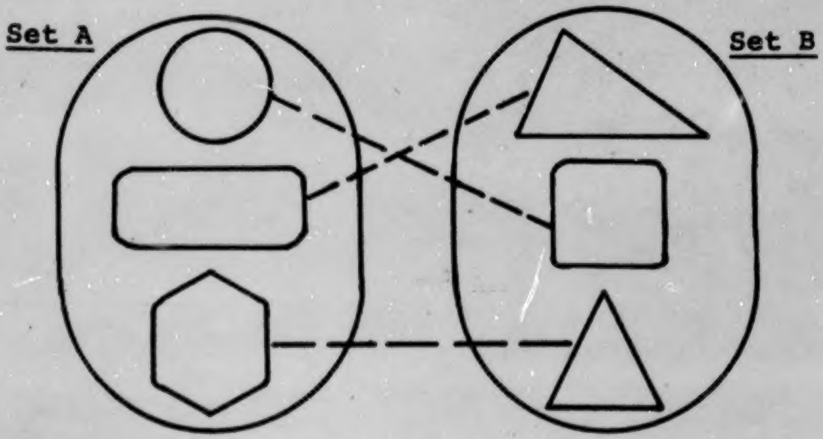
Suggestions For Pupil Activities

Sort attribute blocks, colored rods, interlocking cubes, pattern blocks, geometric shapes or other similar materials according to different criteria, for example, according to color or shape.



A set of a triangle, a square, a hexagon, a rectangle and a circle. Initiate a discussion to:

- Describe each set formed by naming the objects (elements, members) that belong to the set.
- Determine the number of objects in each set formed. (Number property of a set). Associate the number with the symbol for naming the number of objects in the set.
- Identify sets that have the same number of objects. (Equivalent sets). Check by matching one-to-one.



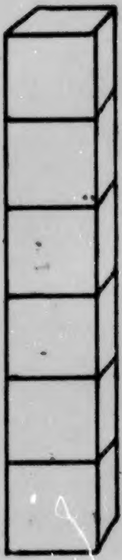
Are there as many blocks in Set A as there are in Set B? How many blocks in Set A? in Set B?

Build other pairs of sets with the same number of objects and write the numeral (symbol) that tells how many objects are in the sets.

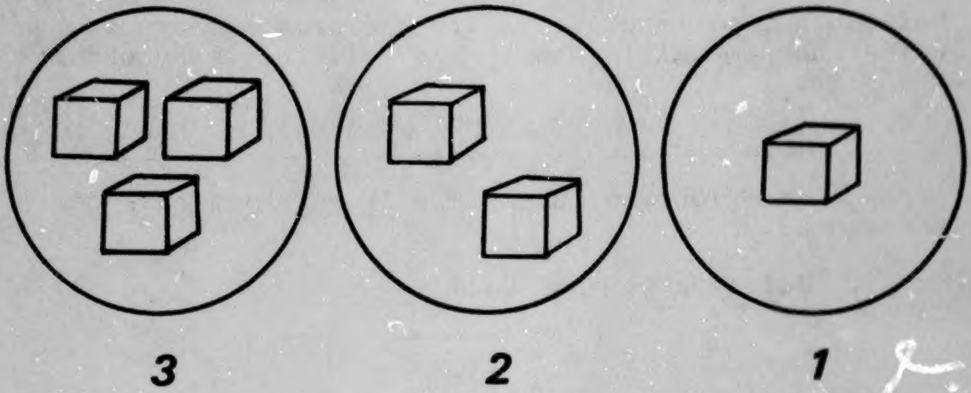
Arrange interlocking cubes into "towers" of any number from 1 through 10.

- **Select a numeral card.**

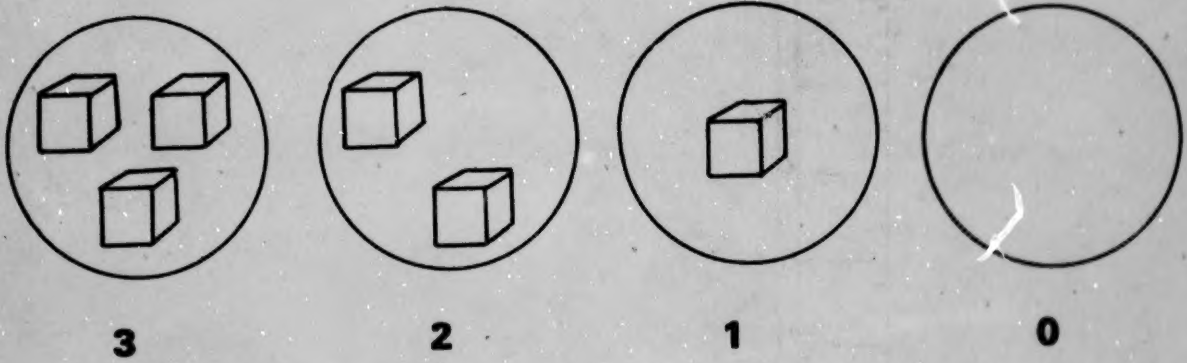
- **Interlock the appropriate number of cubes.**
- **Name the number of cubes in the tower.**



Use cubes or other small objects to build sets containing three, two and one member in that order.

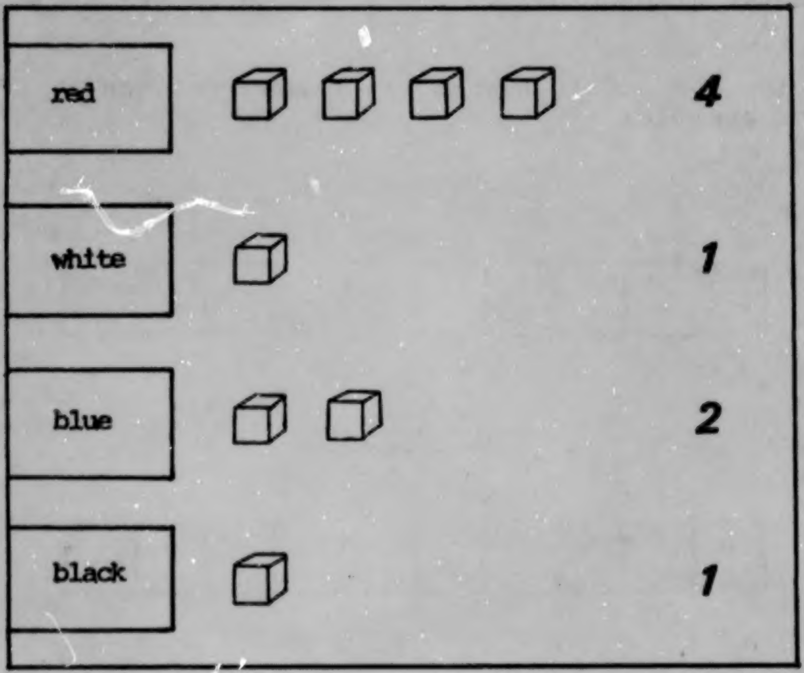


- Discuss the number of each set.
- Make a ring with string next to the set with 1 object.
- Ask - How many cubes are there inside the ring?
- Discuss the idea that there are "None", "Not any" or "Zero" cubes and 0 is the numeral for the number Zero.



Picture the number of various sets in graph form.

- Use cubes of different colors.
- Take a handful of cubes.
- Estimate the number of cubes picked.
- Group cubes of the same color in a column or row.



- Name the number of cubes picked and check with estimate.
- Tell how many cubes of each color there are. (Color subsets)
- Write the appropriate numeral next to each row.

UNIT 2. NUMBER - NUMERATION

Reinforce and/or develop:

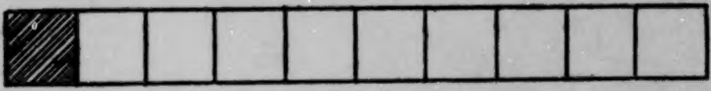
order of the whole numbers
concepts of equality and inequality
use of relation symbols =, <, >

Suggestions for Pupil Activities

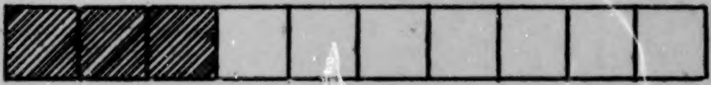
Use centimeter graph paper or scored tagboard strips (squared material).

- Color a specific number of squares on each of 10 strips. For example:

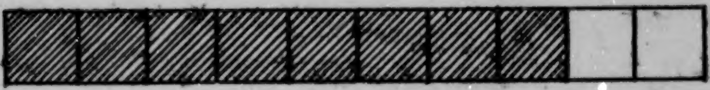
Color 1 square



Color 3 squares

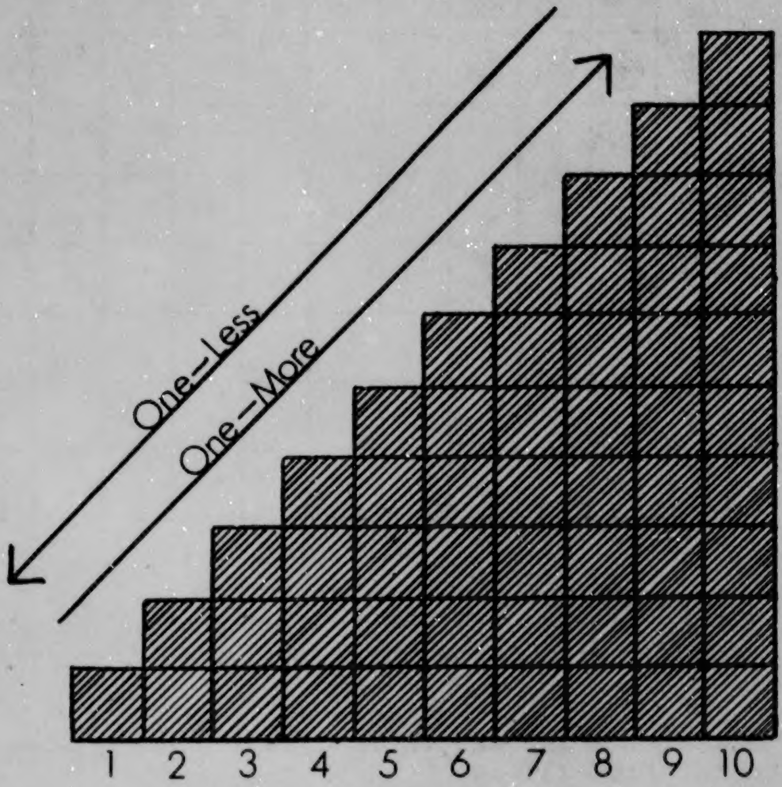


Color 8 squares



and so on through 10 squares.

- Cut off squares not colored on each strip.
- Arrange the strips in a staircase pattern so that each succeeding strip is one unit (square) longer than the preceding strip.
- Label strips with appropriate numeral.
- Discuss the one-more and the one-less pattern shown.

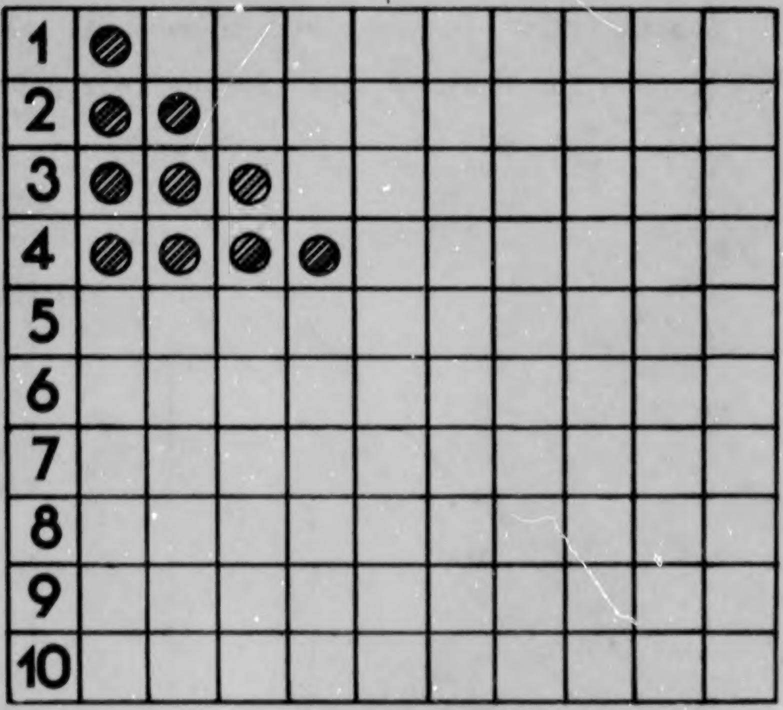


The same activity can be done by constructing "towers" or "trains" of interlocking cubes.

22

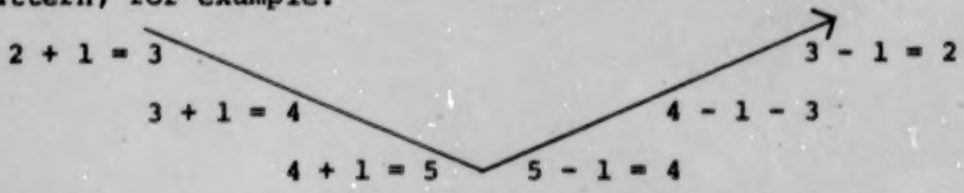
Demonstrate the order of counting numbers in chart or graph form. Use a grid as shown below.

- Place the appropriate number of gummed paper discs or plastic discs in the spaces to the right of the numerals.



- Discuss the number of discs in each row and the idea that each succeeding row has 1 more disc than the row before it.

- Derive addition and subtraction sentences by observing a pattern, for example.

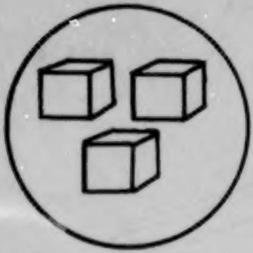

2 + 1 = 3
3 + 1 = 4
4 + 1 = 5
5 - 1 = 4
4 - 1 - 3
3 - 1 = 2

- Some other materials suitable for this activity are: 1 - inch cubic blocks, interlocking cubes and beads on a string.

Assess the pupils' understanding of equalities and inequalities.

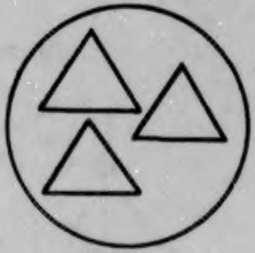
- **Use small objects to form sets with the same number of members. (Equivalent Sets)**

Set A



How many? 3

Set B



How many? 3

Are the numbers the same? Yes
Write the number sentence 3=3

- **Form two sets with different numbers of objects (non-equivalent sets).**

Set A__________ □ □ □ □ □ □ □
Set B__________ ○ ○ ○ ○

- **Match one-to-one and generalize:**

  There are more **squares** than there are circles.
  There are fewer circles than there are squares.
  Set A has 7 objects (squares)
  Set B has 4 objects (circles)

- Introduce symbols for inequalities and use them when comparing the number of members in Sets A and B.

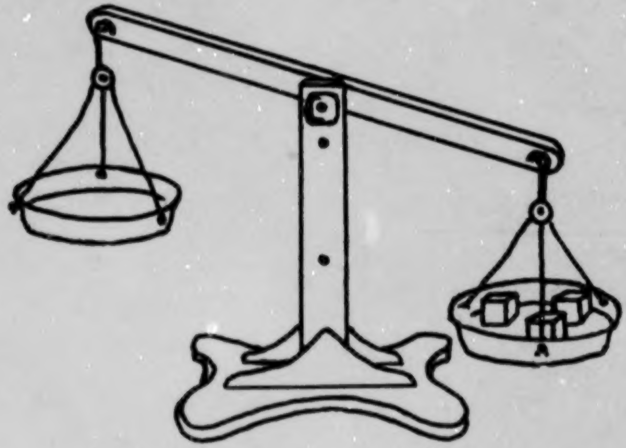
7 is greater than 4 — 4 is less than 7

$7 > 4$ — $4 < 7$

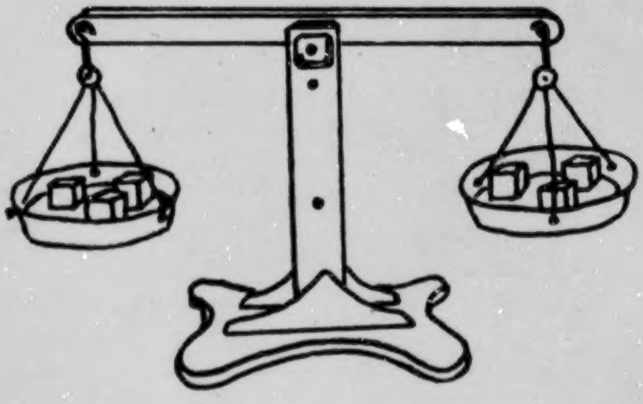
Explore ideas of equality, inequalities and number comparisons with a balance scale. Plastic discs, sugar cubes, interlocking cubes, color cubes, bottle caps or other similar objects can be used for weights.

A - Equality

- Put some cubes on one pan of the scale.



- What happens?
- Make both pans even. (balance)
- Discuss the analogy of the balance on the scale with the equal symbol used in an equation.



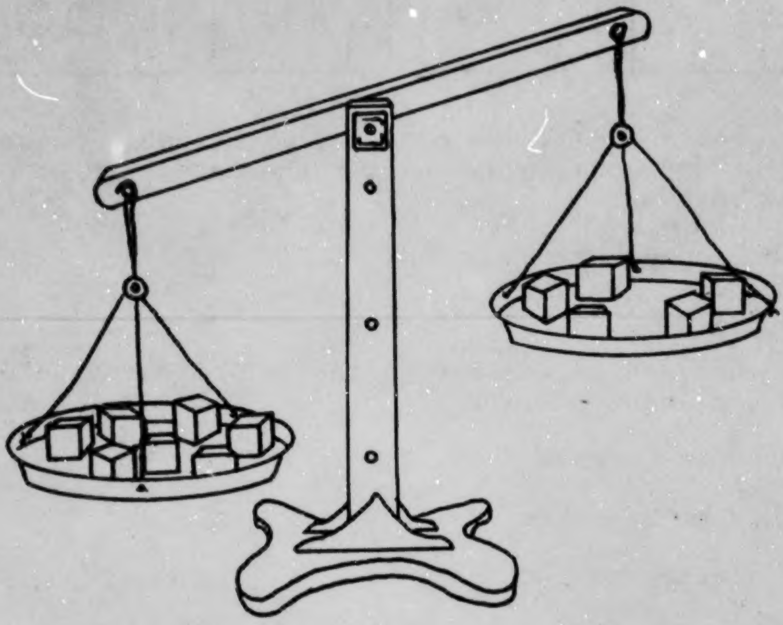
3 = 3

B - Inequality

- Place 5 discs on one pan.
  Is the beam balanced?

- Place some discs on the other pan to make the down side go up.

- Describe the position of the pans and discuss the analogy of the imbalance with the inequality symbols (>,<) used in a mathematical sentence.



$7 > 5$

7 is greater than 5

$5 < 7$

5 is less than 7

C - Other Number Comparisons

- Place cubes on the pans to show that 4<6 (4 is less than 6).

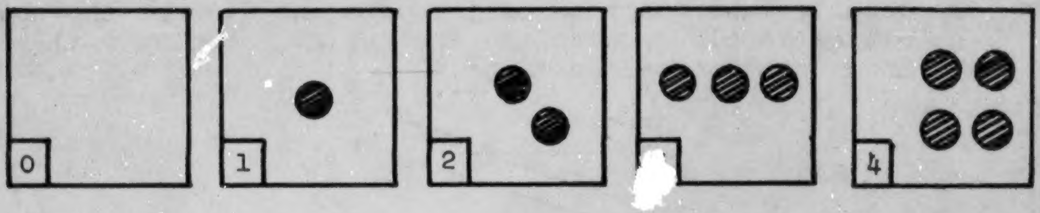
- Is the beam balanced?

- Discuss achieving balance by alternating between adding and removing cubes.

- After each try write number sentences that describe the position of the pans. For example:

  placing 2 cubes on the pan with 4 cubes
  would be $4+2=6$
  removing 2 cubes from the pan with 6 cubes
  would be $4=6-2$

Make sets of spot cards 0-10 similar to the ones shown here.



Use the cards to provide drill and practice with number sequences, order, inequalities and equalities. After the cards are ordered, discuss questions such as:

- What number comes before one?
- Is 6 greater or less than zero?
- Which is the greatest number in the set of cards 0-10? Which is the least number?
- What number is between 7 and 9?
- What number comes after 9?
- How much greater is 7 than 5?
- Which numbers are less than 8?

*

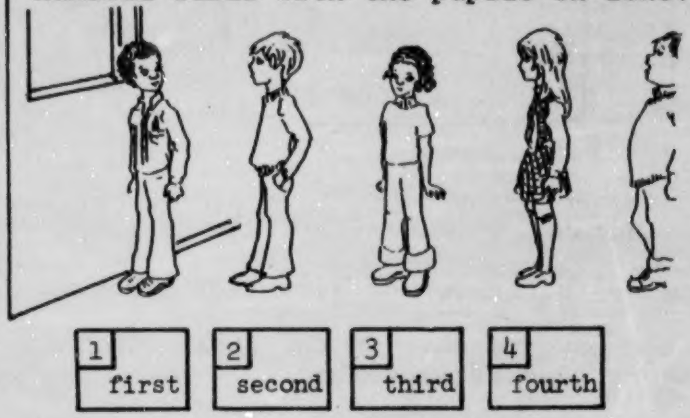
UNIT 3. NUMBER: ORDINALS

Recall first through tenth from any direction. Extend the sequence of ordinal numbers through twentieth and beyond.

Suggestions for Pupil Activities

Associate the ordinal terms first through tenth with the members of an ordered set.

- Ten children line up one behind the other in single file.
- Establish a line of direction, for example, "face toward the door".
- Count the children standing to determine the number of pupils standing.
- When counting one, two, . . . ten other pupils match numeral cards with the pupils on line.

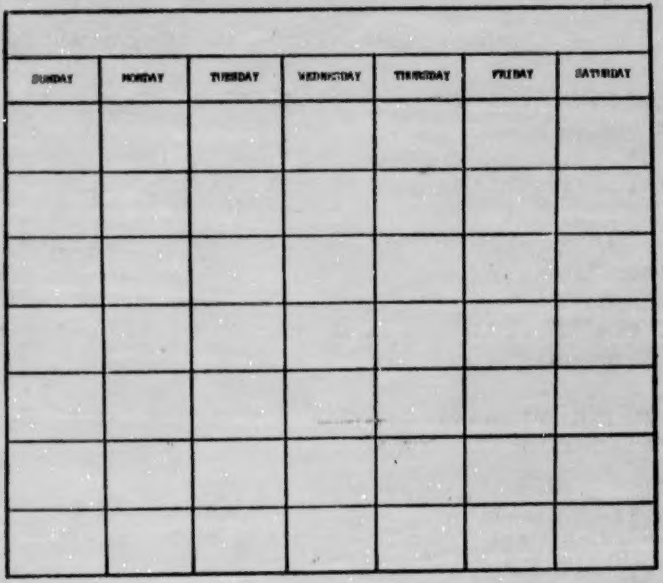


- Discuss:
  Who is third? Why?
  Is Frances fifth?
  What is Philip's place on line?
  What color shoes is the ninth child wearing?
- Change the line of direction and identify each child's position.
- Invite an additional pupil to join the line. Determine the number of pupils standing now. Identify the last child on line as the eleventh and introduce the card.

- Continue through twentieth.

Use ordinal terms when referring to a calendar page.

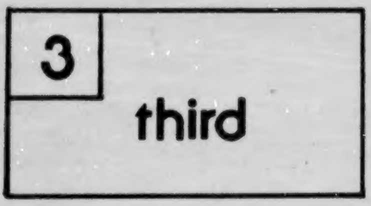
- Complete a calendar page for the current month.

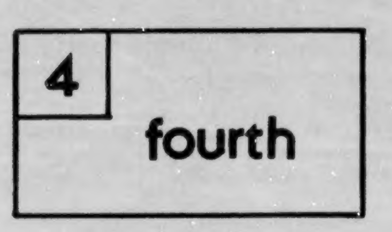


- Determine how many days there are in one week. Name the first, second, . . . seventh day of the week.
- Determine the number of days in the month.
- Give the day and date in the form: Thursday, the eighteenth day of September.

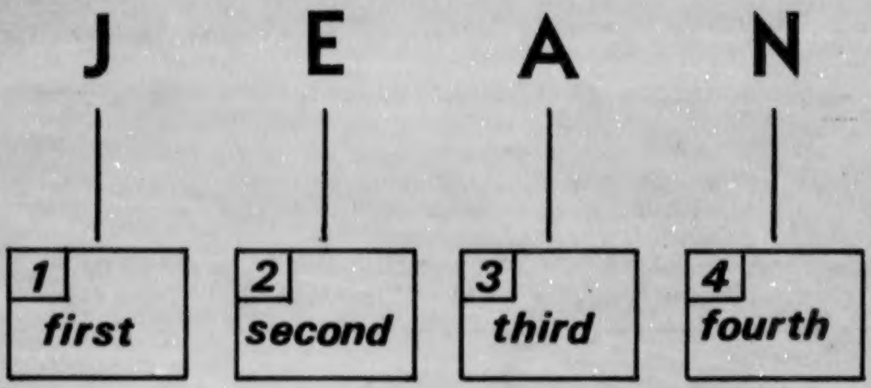
Match letters in a name with the ordinal terms.

- Prepare sets of cards similar to:



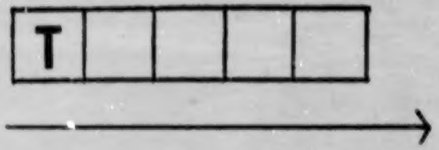


- Write name and position cards as shown.



Play a "Secret Word" game.

- Use strips of paper with a specified number of squares.



- Establish the line of direction from left to right.

- Follow directions:
  write T in the first square.
  write E in the fourth.
  write G in the third space.
  write I in the second square.
  Where does R belong?

- What is the "Secret Word"?
  How many letters does it have?
  Is there a sixth letter in the word?

Understanding and using ordinal numbers are ongoing goals and should be maintained by taking advantage of daily situations. Emphasize use of ordinal terms to express the order of:

position in line for a relay race
pages in a book
streets or avenues
rows in the auditorium
shelves in a closet or bookcase
tables in a classroom
events in a day, a story or a procedure
months of the year (See Unit 11)

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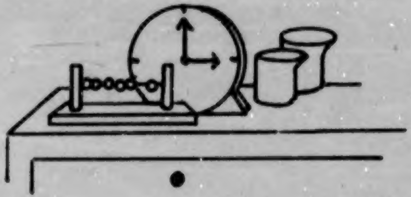
UNIT 4. GEOMETRY

Use physical representations to picture geometric ideas such as: point, line segment, line and ray

Suggestions for Pupil Activities

A. Point; Line segment

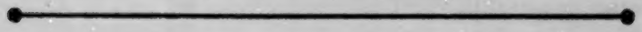
- Involve the children in making a picture of the classroom.
- Use an acetate sheet for the overhead projector, the chalkboard, or a piece of newsprint to illustrate segments.
- Discuss ways of marking the spot to show location of several work play centers.



- Have children demonstrate various paths they may take from the easel to the mathematics table.
- Determine which path from the easel to the mathematics table is the shortest.
- Discuss:

  the shortest path is a straight path

  the straight path from one dot (point) to another may be thought of as a line segment



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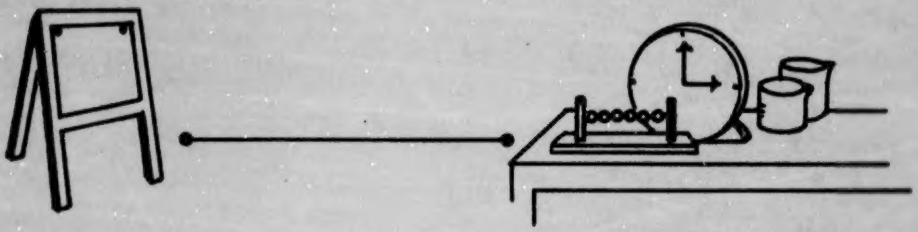
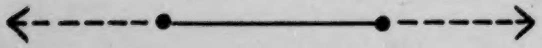
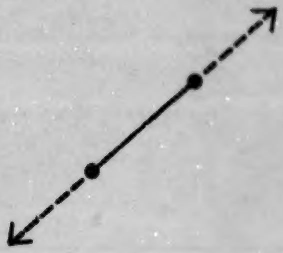


B. Line

Have children use a straight-edge to draw pictures of line segments.

Extend the line segments in both directions to show representations of line.





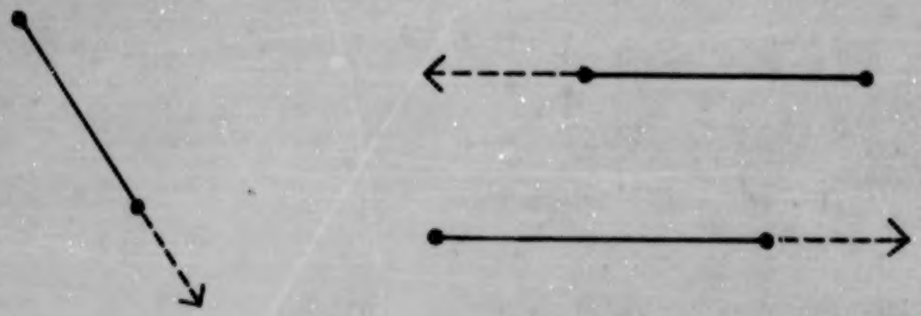
Compare model of a line with a line segment and make observations such as:

a line extends infinitely in either direction
a line segment is part of a line
a line segment has 2 endpoints
arrows are used to indicate that there is no end to a line

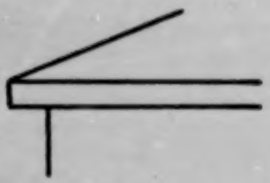
C. **Ray**

Have children draw pictures of line segments. Extend the line segment in one direction to show representations of rays.

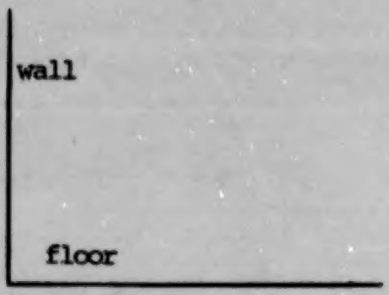
Compare with segments of lines.



Make lists of objects in the classroom, home, and community that suggest points, line segments, rays.



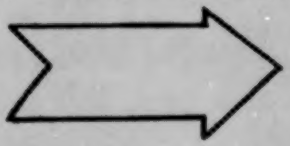
edge of desk



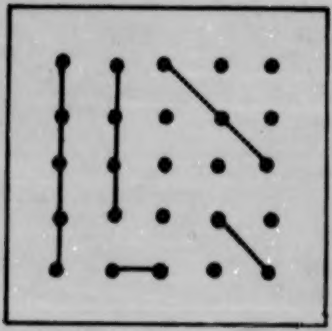
corner of classroom

search light

one-way sign



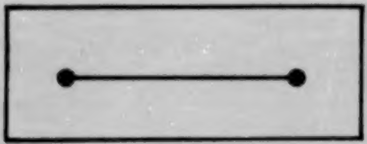
Form models of line segments on a geoboard by stretching a rubber band between any two nails. The nails may be considered as endpoints.



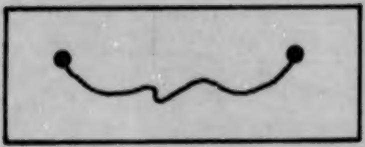
Investigate ideas such as the following:

- Form 5 line segments of different lengths.
- How many nails are touched by each line segment formed?
- Form the longest (shortest) line segment that you can.
- Which is longer a line segment formed vertically (horizontally) or one formed diagonally between two dots?

Use pictures and/or diagrams to provide an intuitive introduction to the geometric concept of line segment.



Line Segment



Not a line segment

Discuss:	What is the same?	Both have 2 endpoints.
	What is different?	One is straight.

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UNIT 5. MATHEMATICAL SENTENCES

Reinforce concepts of a mathematical sentence: true, false, open; use of placeholder(s); use of symbols +, -, =, >, <.

Suggestions for Pupil Activities

Use a classroom information chart to relate the concept of true, false, and open sentences to sentences on the chart.

Class 2-107

Today is ____________________.

______boys are present.

______girls are present.

______children are absent.

Discuss:

- Can we tell whether these sentences are true or false? Why? (Idea of open sentence)
- What is used to show that some word is missing? (Idea of placeholder)
- How would you complete these sentences to make them true? To make them false (not true)?
- Compare an incomplete sentence with an open mathematical sentence such as $3+2=\square$. Note similarities and differences.

Interpret a completed calendar page (See Unit 3) and make comparisons that involve use of the symbols $>$, $<$, +, -, =.

- Ask: Are there more Mondays than Saturdays in this month?
  How many Mondays are there? (5)
  How many Saturdays are there? (4)
  Which number is greater? Less?
  Express the relationship in mathematical sentences.
  $5 > 4$ Read as: 5 is greater than 4
  $4 < 5$ Read as: 4 is less than 5

- Write and complete open sentences for finding:

  a. the total number of school days in the first two weeks of the month.

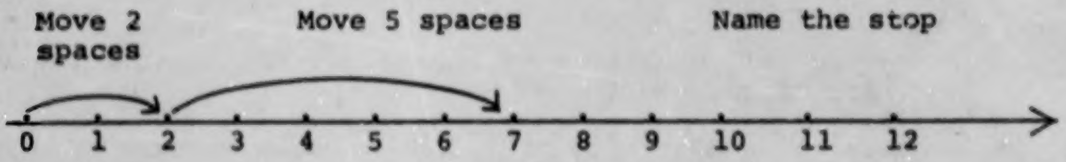
  $5+4=\triangle$

  b. the difference between the number of Saturdays and the number of Mondays.

  $4+\square = 5$ or $5-4=\square$

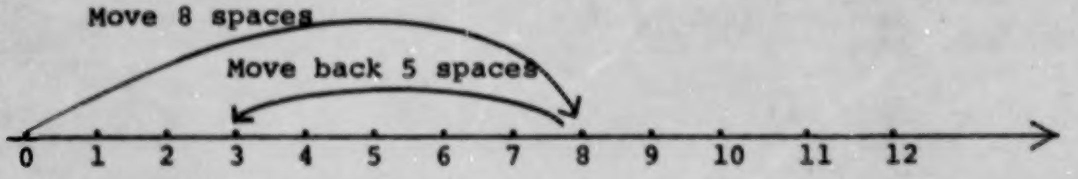
Make use of walk-on numberline chalkboard or prepared number levels as an aid in developing the objective of this unit.

- Derive addition sentences that describe moves on a number line. Start at zero.



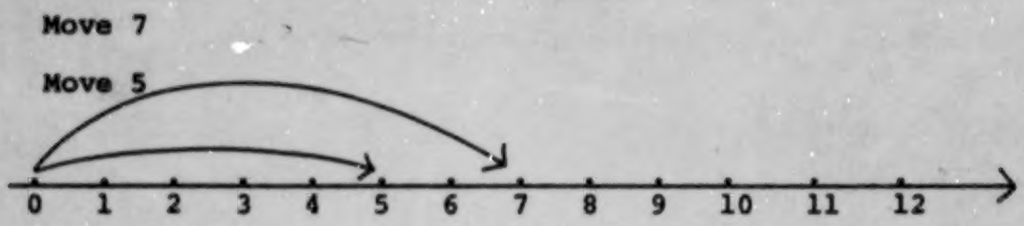
$2 + 5 = 7$

- Derive subtraction sentences that describe moves on a number line. Start at zero.



$8 - 5 = 3$

- Derive statements of inequality.



Compare 5 and 7: Which number is further to the right of the zero?
Which number is closer to the zero?
Which is greater? Which is less?

Write: $7>5$ $5<7$

Make use of open sentences when reviewing arithmetic skills.

- Show an open sentence with 2 placeholders that are different in shape.

  □ + △ = 14

- Name pairs of numbers that will make the open sentence true. Organize the responses on a chart.

□	△
8	6
5	9
9	5
4	10
11	3
7	7

etc.

- Show: □ + □ = 14 and compare it with □ + △ = 14.
- Discuss: When both placeholders are the same shape the same numeral must be used for each frame. When both placeholders are not alike the same numerals may or may not be used.
- Name the pair of numbers that makes □ + △ = 14 true.
- Make other open sentences true according to the rules of substitution.

*

UNIT 6. NUMBER - NUMERATION

Reinforce and/or develop place value concepts:

a. grouping by tens and ones and recording in expanded form, e.g.,

1 ten + 3 ones
10 + 3 = 13

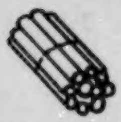
b. grouping and counting by tens through 1 hundred

SUGGESTIONS FOR PUPIL ACTIVITIES

A. Demonstrate counting and grouping by tens and ones with materials such as: bundles of sticks, interlocking cubes, bead frames, arithmetic blocks, squared materials, pegs and pegboard.

- Recall that 10 ones = 1 ten
  Count: one, two, three,...ten

- Regroup ten ones as 1 ten



- Record: 1 ten = 10
- Make groups of ten and discuss the number of bundles of 10; the number of single sticks and the number of sticks in all.

1 ten + 3 ones = 13

39

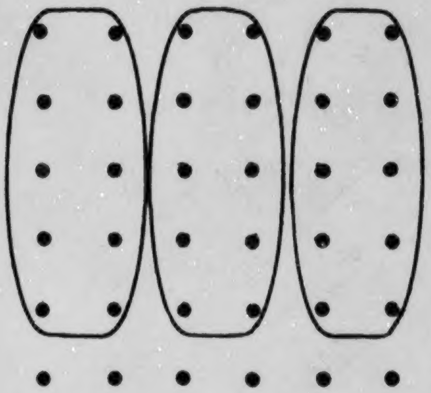
- Name the number as the number of tens plus the number of ones. (Expanded notation).

$$\underline{1}\text{ ten} + \underline{3}\text{ ones}$$
$$10 + 3 = 13$$

- Consider the numeral 13 and discuss the meaning of the digit 1 as 1 ten or 10 and the digit 3 as 3 ones or 3.

- Similarly show the place value meaning of other 2-digit numerals

Find out how many dots there are on a given dot grid by counting and combining groups of 10.



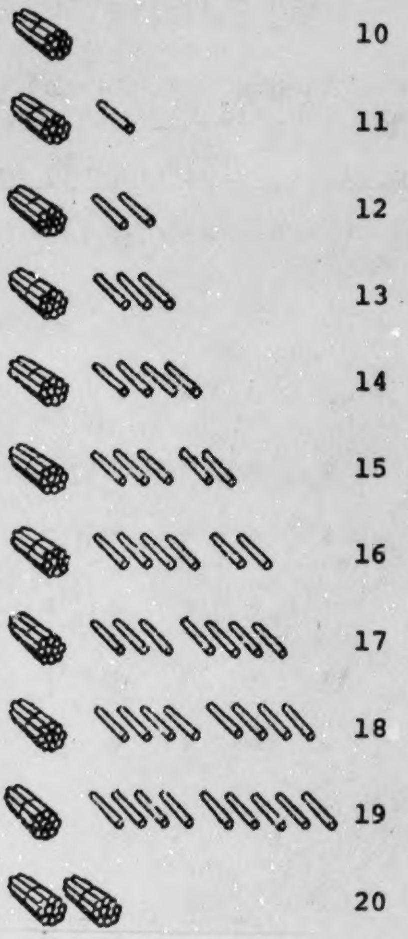
36 dots

3 tens + 6 ones
30 + 6 = 36

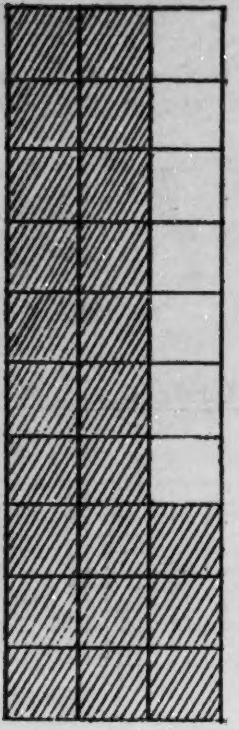
Represent 2-digit numerals on graph paper by counting and shading groups of tens and ones

40

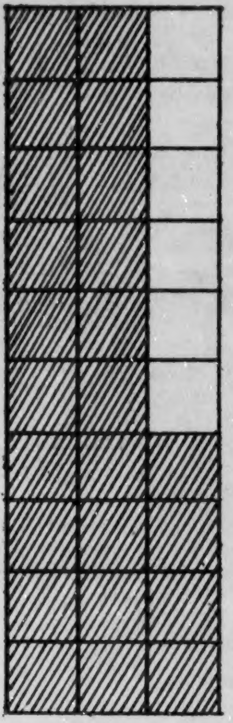
Organize sets of objects to show the sequence of the numbers 10 - 20.



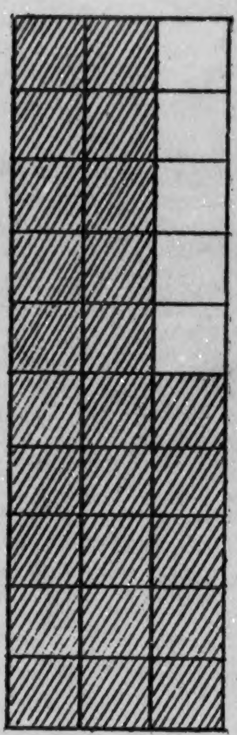
- Discuss the meaning of each digit in the standard numeral, for example, 12 as 1 ten + 2 ones.
- Name each number in expanded form, e.g., 17 = 10 + 7
- Compare pairs of numbers
- Similarly, order other number sequences



2 tens + 3 ones
20 + 3 = 23



2 tens + 4 ones.
20 + 4 = 24



2 tens + 5 ones
20 + 5 = 25

B. Develop counting by tens.

- Use sticks, interlocking cubes, tens strips (squared material), multibase arithmentic blocks or other similar materials to form sets of 10.

- Arrange sets of ten in order so as to form a graph

	1 ten	**10**
	2 tens	**20**
	3 tens	**30**
	4 tens	**40**
	5 tens	**50**

and so on to 10 tens or 100

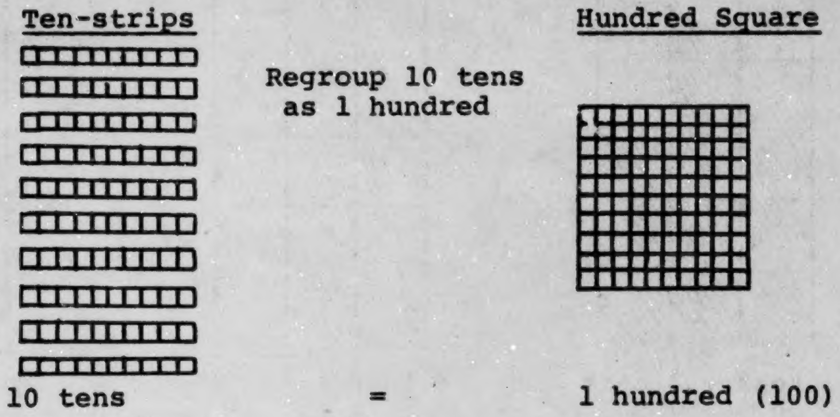
- Count sets of ten as: 1 ten, 2 tens, 3 tens, 4 tens, ...10 tens and as: ten, twenty, thirty, ...1 hundred

- For each set of tens tell how many tens and write the numeral for the number of tens.

- Compare sets of tens. Express the comparison in mathematical sentences, for example, 4 tens > 3 tens.

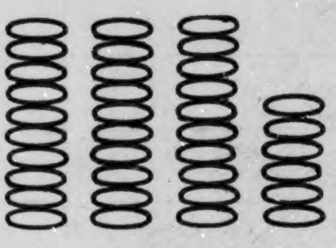
- Look for and discuss patterns in the arrangement. For example, each succeeding row of tens has 1 more ten than the one before it.

Use place value materials to demonstrate counting by tens. Emphasize the regrouping or exchanging idea when going from 90 to 100.



Sort large piles of discs into piles of ten.

- Take two handfuls of discs.
- Estimate (guess) the number of discs.
- Make as many stacks of ten as you can.
- Count and write an addition sentence that tells how many discs you have.



10 + 10 + 10 + 6 = 36

- Check with your estimate.

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UNIT 7. MEASUREMENT: MONEY

Develop and/or extend the understanding of relationships between and among penny, nickel, dime, and quarter.

Suggestions for Pupil Activities

A. Use collections of pennies and nickels to develop the relationship of pennies to nickels.

- Identify coins by name, size, color and shape. Discuss the value and symbols for each coin.

Penny

1¢

1 cent

Nickel

5¢

5 cents

- Count and arrange 5 pennies in a row. Tell the value of the set of coins.

5 pennies ⟶ 5 cents

- Select 1 coin that has the same value as 5 pennies.

5 pennies
5¢

1 nickel
5¢

- Summarize
  1 nickel has the same value as 5 pennies

B. Picture the relationship of pennies to dimes; of nickels to dimes

- Count and arrange 10 pennies in piles of 5 pennies each. Tell the value of the set of coins.

10 pennies

one dime

- Select one coin that is equivalent in value to 10 pennies.

10 pennies
10¢

1 dime
10¢

- Replace each pile of 5 pennies with one coin of the same value. Determine the value of the set. Find the one coin that has the same value as the 2 nickels.

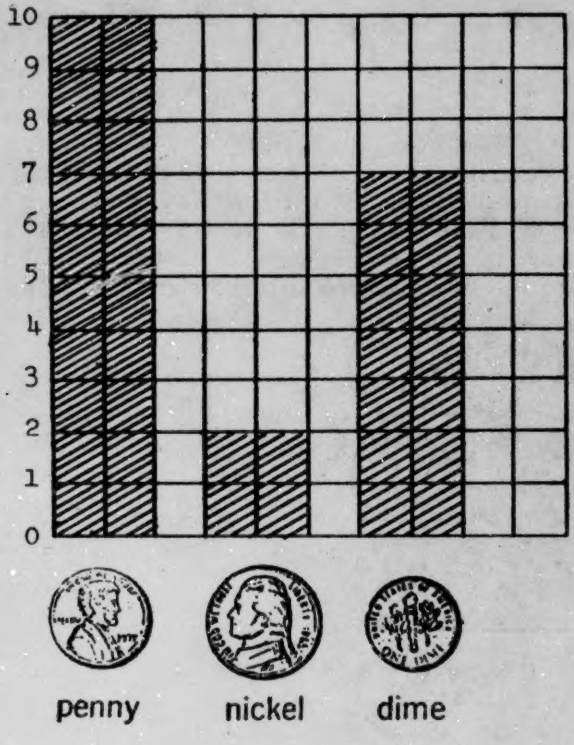
5 cents + 5 cents
5¢ + 5¢

10 cents
10¢

- Summarize:

  1 dime has the same value as 10 pennies.
  1 dime has the same value as 2 nickels.

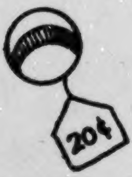
Use collections of pennies, nickels and dimes to explore money values. Sort the coins according to value in muffin tins, egg cartons or other divided boxes. Show how many coins of each kind there are by making a graph.



Discuss:

How many pennies are there? nickels? dimes?. What is the value of the set of pennies? the set of nickels? the set of dimes?. Which coin do you have most of? least of?. Which is greater in value, 10 pennies or 7 dimes?

Set up a store in the classroom.



- Prepare price labels.
- Choose the coin or set of coins needed to buy the articles.
- Make change from a dime; from a nickel.
- Estimate amount of change and check the estimate after receiving the change.
- Discuss different coins that can be used to buy the articles.

- Buy more than 1 item and tell the amount spent.
- Devise and solve original word problems such as:

Joe paid for the ball with 2 coins. Which ones?
Carla paid for the ball with 11 coins. Which ones?
(See Unit 18 for additional suggestions on problem solving.)

Use sets of coins to picture relationships among pennies, nickels and quarters. To identify coins that are equivalent in value to a quarter, arrange 25 pennies in piles of 5 pennies each. Determine the value of the set. Find one coin that has the same value as the collection of 25 pennies.

25 pennies
25¢

1 quarter
25¢

Replace each pile of 5 pennies with one coin of the same value. Determine the value of the set. Find the one coin that has the same value as the collection of 5 nickels.

5 cents
5¢

5 cents
5¢

5 cents
5¢

5 cents
5¢

5 cents
5¢

1 quarter

Summarize: 25 pennies = 1 quarter
5 nickels = 1 quarter

Initiate discussions which emphasize the value of money, for example, allowances, earning money, saving money. Relate real experiences to the discussion. One might be, "If you save a dime a week how long will it take to save fifty cents?

Treat Units 7, 23 and 48 as topics for on-going study throughout the year. Take trips to neighborhood stores to purchase items for parties, special events, etc. Suggest out-of-school activities to parents to help the pupils deepen their understanding of money values.

UNIT 8 NUMBER: GRAPHS

Reinforce and extend number concepts by graphing points on horizontal and vertical number rays or number lines

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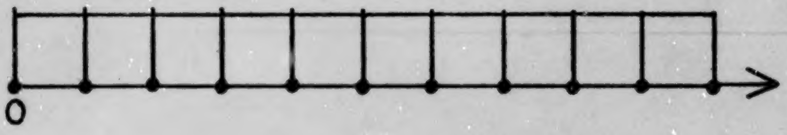
SUGGESTIONS FOR PUPIL ACTIVITIES

Involve the pupils in marking and labeling number rays ($\overrightarrow{0\ 1\ 2\ 3}$) and/or number lines ($\overleftrightarrow{0\ 1\ 2\ 3}$) on strips of centimeter graph paper.

- Mark points on a ten strip and label the first point zero as shown.

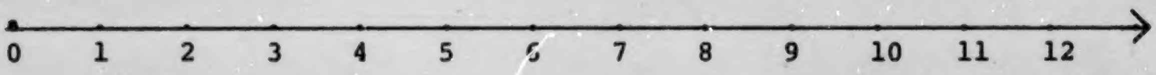


- Start at zero and move one space to the right. What number name would you give that point? (1) Label 1.
- Start at zero and move two spaces to the right. What number name would you give that point" (2) Why? Label it 2. Emphasize that the point named 2 is two spaces from zero.
- Similarly move along the ray until the strip is labeled with the numerals 0 to 10.
- Count the number of squares to review the concept of ten.

Through discussion and questioning generalize:

- As we move to the right on the number ray, the numbers named are greater.
- As we move to the left on the number ray the numbers named are less.
- By extending the ray to the right and marking off equal units, numbers greater than ten can be named in order.

Models of number rays can also be made with interlocking cubes or with line segments formed on dot grids.

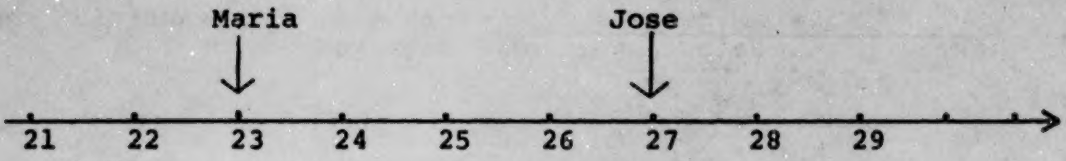


Pairs of children can play number ray games, such as Mark the Number.

- Pupils take turns dropping a disc on a target.

23	25	27
20	24	22

- Each child marks the number on which the disc falls by darkening (graphing) the corresponding point on a number ray.



- Compare scores
  27 is to the right of 23; 27 is greater than 23, so 27 is the greater score

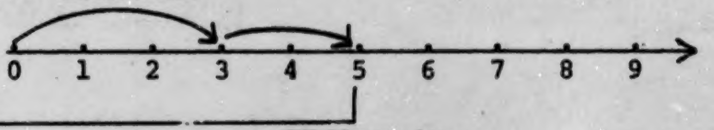
  23 is to the left of 27; 23 is less than 27, so 23 is the lesser score.

- Write number sentences using the relation symbols >, <, =, to describe the scores.

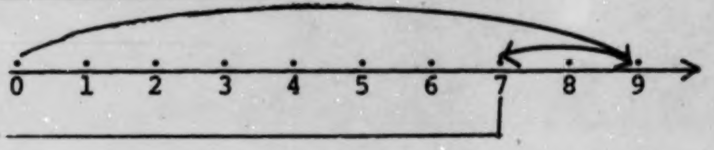
$23 < 27$ $27 > 23$

Use number rays to picture (graph) solutions of number sentences.

Complete Sentences — Darken the point that corresponds to solution



$3 + 2 = \boxed{5}$



$9 - 2 = \boxed{7}$

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UNIT 9.- ADDITION OF WHOLE NUMBERS

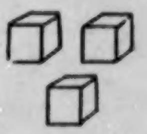
Reinforce basic facts, sums through 10.
Develop basic facts, sums 11 and 12.
Observe and use the:
  Commutative Property of Addition $9 + 2 = 2 + 9$
  Associative Property of Addition $(9 + 1) + 1 = 9 + (1 + 1)$

SUGGESTIONS FOR PUPIL ACTIVITIES

I. Review basic facts (sums through 10)

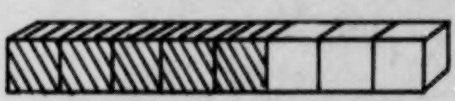
A. Combine sets of objects and derive addition sentences.
- Select cubes of 2 different colors.

5 green



3 yellow

- Join or interlock the two sets of cubes and tell how many cubes have been joined.

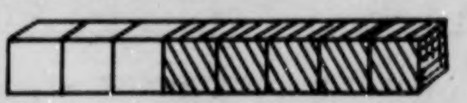


8 blocks

- Write an addition sentence to describe the action

$$5 + 3 = 8$$

- Reverse the order of the cubes and write another addition sentence



$$3 + 5 = 8$$

- Record vertically also $\begin{array}{r} 5 \\ +3 \\ \hline 8 \end{array}$ $\begin{array}{r} 3 \\ +5 \\ \hline 8 \end{array}$

- Optional

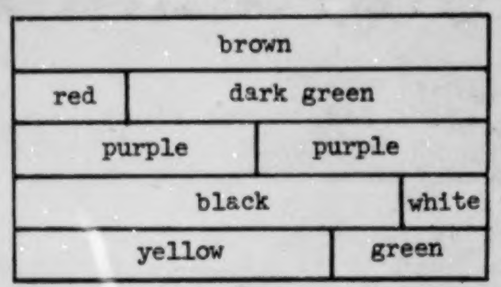
  Compare 3 + 5 = 8 and 5 + 3 = 8.
  Discuss similarities and differences.
  Conclude that the sum (8) is the same but the order of the addends (numbers) is different. (Commutative property of addition).

B. Build models of sums 1-10 with colored rods.

- Select a brown rod. Find out how many white rods cover the brown rod. Agree to assign the number 8 to the brown rod.

- Match the brown rod with two rods which when placed end to end are as long as the brown rod. *Note: Combinations of 2 rods are encouraged at this time since the objective is to review basic addition facts.

- Describe the different color combinations that match the brown rod in terms of numerical values. Find out or recall how many white rods cover each rod used in the model, and then write the appropriate addition sentence. For example:



8 + 0 = 8
2 + 6 = 8
4 + 4 = 8
7 + 1 = 8
5 + 3 = 8

and so on

- Observe and discuss the commutative property.

  Red and Dark Green 2 + 6 = 8
  Dark Green and Red 6 + 2 = 8

Note: Developing automatic recall to basic addition facts with sums through ten is an on-going goal. Therefore, frequent and varied drills throughout the year should be used for this purpose. See Units 13, 16 and 21 for additional suggestions.

II. Develop the basic facts with sums 11 and 12 by applying the associative (grouping) property of addition.

For 9 + 2 = 11

- Reinforce sums of 10. Use objects such as colored rods, beads, interlocking cubes or patterns such as:

9 + ☐ = 10

8 + ☐ = 10

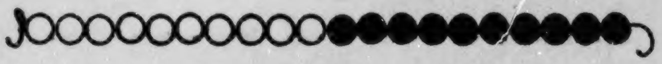
7 + ☐ = 10

6 + ☐ = 10

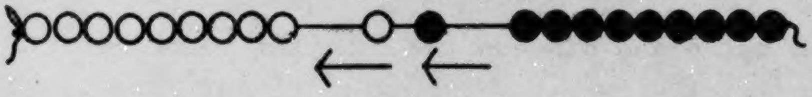
5 + ☐ = 10

Discuss the missing numbers in terms of how many more are needed to make ten.

- Use individual strings of 20 beads, 10 each of 2 different colors.



Direct as follows:
Start with all beads on the right.
Move 9 beads to the left.
How many beads should be moved to show 10 beads on the left.
Show 10 beads.
Move 1 more bead to the left.
How many beads are on the left? (11)



9 + 1 + 1 = 11

- Summarize by writing and discussing the equations that describe the moves.

(9 + 1) + 1 = 11
10 + 1 = 11

9 + (1 + 1) = 11
9 + 2 = 11

Note: The second addend 2 is numerically renamed as 1 + 1 and visually renamed as 1 green bead and 1 blue bead.

- Similarly proceed with:

8 + 3 = 11
9 + 3 = 12

7 + 4 = 11
8 + 4 = 12

6 + 5 = 11
7 + 5 = 12
6 + 6 = 12

**

UNIT 10. SUBTRACTION OF WHOLE NUMBERS

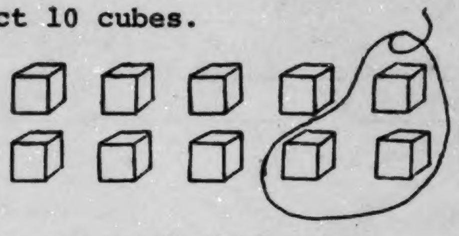
Reinforce basic facts, sums through 10.
Develop basic facts, sums 11 and 12.
Observe and use the principle of inverse operations.
Record horizontally and vertically, e.g., 12 - 3 = 9, $\begin{array}{r}12\\-\ 3\\\hline 9\end{array}$

Suggestions for Pupil Activities

I. Review basic facts (Sums through 10).

A. Remove subsets of objects and derive subtraction sentences.

- Select 10 cubes.



- Remove any number of cubes.
- Tell how many are left.
- Record results in chart form.

Cubes	Remove (Take Away)	Left
10	3	7

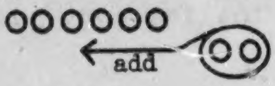
- Select a different number of cubes and repeat the procedure.
- Translate the data on the chart into subtraction sentences.

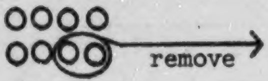
10 - 3 = 7

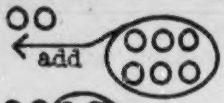
54

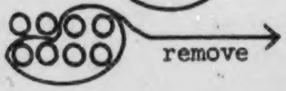
B. Investigate the inverse relationship between addition and subtraction with objects such as 1-inch cubic blocks, interlocking cubes, discs, beads on a frame, colored rods.

Direct as follows:

- Show: 

Write: 6 + 2 = 8
- Show: 

Write: 8 - 2 = 6
- Show: 

Write: 2 + 6 = 8
- Show: 

Write: 8 - 6 = 2

- Organize the basic facts into a "number family".

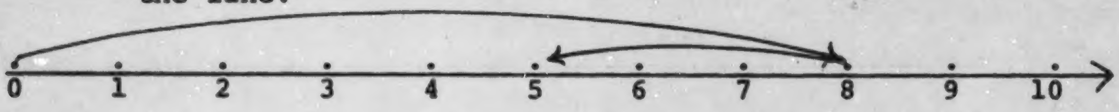
6 + 2 = 8	8 - 2 = 6
2 + 6 = 8	8 - 6 = 2

- Discuss why those four facts are called a "number family". (The same three numbers are used)

Us[illegible] number lines to demonstrate subtraction facts.

Direct as follows:

- Start at zero and move 8 spaces. Name the stop.
- Move back 3 spaces. Name the stop.
- Write a subtraction sentence to describe the moves on the line.



8 - 3 = 5

II. Develop the basic subtraction facts, sums 11 and 12 using the idea of "subtracting to ten first".

- Complete a series of open sentences such as:

11 - □ = 10

12 - □ = 10

13 - □ = 10

14 - □ = 10

15 - □ = 10

Discuss the missing numbers in terms of how many subtracted to reach 10, for example: 1 is subtracted from 11 to reach 10; 2 is subtracted from 12 to reach 10; and so on.

  - Use individual strings of 20 beads, 10 each of 2 different colors. (See Unit 9)

    Direct as follows:

    Start with all beads on the right.
    Move 11 beads to the left.
    How many beads should be moved back to show 10? (1 bead)
    Move back one more bead.
    How many beads are on the left now? (9)

- Summarize by writing a subtraction sentence about the action, e.g., 11 - 2 = 9.

- Similarly derive:

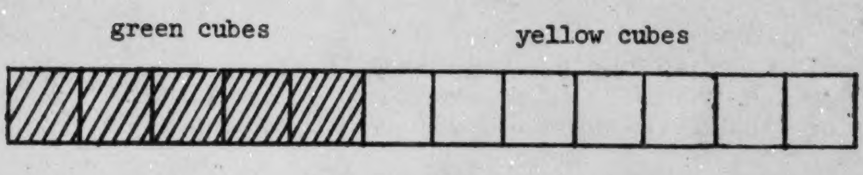
11 - 9 = 2
11 - 8 = 3
11 - 7 = 4
11 - 6 = 5
11 - 5 = 6
11 - 4 = 7
11 - 3 = 8
11 - 2 = 9

12 - 9 = 3
12 - 8 = 4
12 - 7 = 5
12 - 6 = 6
12 - 5 = 7
12 - 4 = 8
12 - 3 = 9

Derive subtraction facts from known addition facts using beads, discs, interlocking cubes, 1-inch cubic blocks, number lines, or other similar materials.

We know 5 + 7 = 12   Derive 12 - 7 = 5 and 12 - 5 = 7.

- Use cubes to form a train of 5 green cubes and a train of 7 yellow cubes.
- Join the "trains" and write an addition sentence.



5 + 7 = 12

- Remove 7 yellow cubes. How many cubes are left?
- Write a subtraction sentence.
  12 - 7 = 5
- Put back the 7 cubes. Remove 5 green cubes.
  How many are left?
- Write a subtraction sentence.
  12 - 5 = 7
- Generate other subtraction facts.

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UNIT 11. MEASUREMENT: TIME (CALENDAR)

Reinforce concepts of time with respect to days and weeks. Develop concepts of time with respect to months and years.

Suggestions for Pupil Activities

Use a completed calendar page for the current month to review ideas about days and weeks. (See Unit 3)

OCTOBER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			①	2	3	4
5	6	7	⑧	9	10	11
12	13	14	⑮	16	17	18
19	20	21	㉒	23	24	25
26	27	28	㉙	30	31	

- Circle 1, 8, 15, 22, 29.
- Name the day on which each date falls.
- Count the number of days from the first through the eighth; from the eighth through the fifteenth; and so on;
- Discuss the interval of time between each date as a period of 7 days or 1 week.
- Investigate how many days in 2 weeks; 3 weeks;
- Refer to the calendar page and answer questions such as:
  On what day of the week does this month begin?
  On what day of the week does this month end?
  How many days are in this month?

- Discuss the interval of time from the first day of the month through the last day of the month as a period of 1 month.

- Compare 1 month with 1 week. Which is a longer (shorter) period of time?

Develop a "feeling" for the concept of week through the use of cooperative activities.

- Keep individual records of special events for 1 week or 7 days starting with the first school day of any week. Each day record:

Day	Event
Monday	Saw a play given by class 2-102
Tuesday	Used the geoboards
↓	↓
Sunday	Visited the zoo

- Note how many days are listed. Discuss the idea that 1 week has passed since the listing started.

Use a calendar for the current year. Investigate the number, the names and the sequence of the months of a year. Observe that each new month begins on the day after the preceding month ends. Compare calendar months with respect to the number of days. Record the data in chart form.

Month	Days
January	31
February	28 (or 29)
March	31

etc.

Examine the information on the chart and answer questions such as:
How many months are listed?
Does each month have the same number of days?
Which months have the most days?
Which one has the least days?
Which months have the same number of days?

Find out "how long a month is" by recording the weather for each day of the month on a large calendar page. Use pictures, words or other symbols to represent sunny, cloudy, rainy, snowy days. At the end of the month read and interpret the chart to answer questions about the weather, such as:

> How many rainy days in this month?
> How many sunny (cloudy) days?
> Did it snow any day this month?

Discuss the idea that 1 month has passed since the weather record was started.

__Note__: The ideas developed in Unit 5 (Mathematical Sentences) could be applied here. For example, 18 13 could be used to compare the number of rainy days with the number of sunny days.

Collect data concerning the birthday months of the pupils and the teacher.

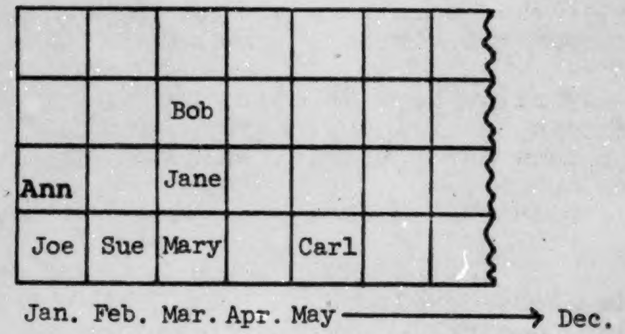
> Ann-Jan., Bob-Mar., Joe-Jan., Sue-Feb., Jane-Mar., Carl-May, Mary-Mar., etc.

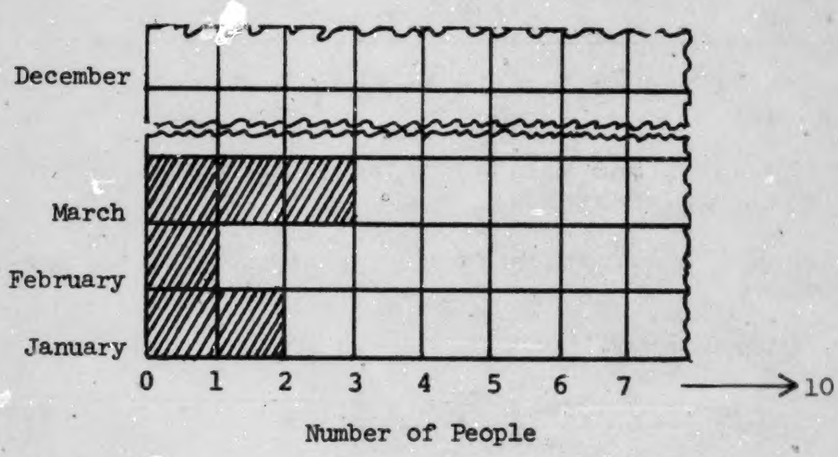
Organize the information in ways that make it easier to read and compare.

: Mapping

Jan.	Feb.	Mar.	Apr.	May
Ann	Sue	Jane		Carl
Joe		Mary		

. Graphing





Read the graphs to answer questions like these:

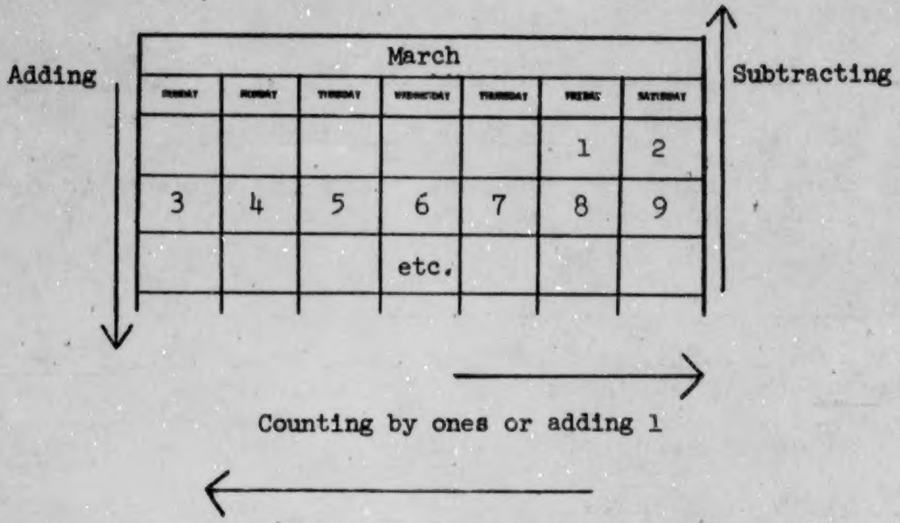
How many birthdays are there in January? February, and so on.
Which month has the greatest (least number of birthdays?)
Which month has no birthdays?
How many birthdays are there in the third month of the year?
How many birthdays are there in the first four months?

Use a number sentence to show the total number of birthdays in January, February and March.

$$2 + 1 + 3 = 6$$

How many months are listed?

Complete calendar pages for each school month. Identify counting patterns in the series of numerals in each row and in each column.



March						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1	2
3	4	5	6	7	8	9
			etc.			

Counting by ones or adding 1

Counting backward by ones or subtracting 1

Note: Skill in using the calendar and in developing an understanding of the concepts of day, week, month and year are ongoing goals. Therefore continuous reference to the calendar should be encouraged.

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UNIT 12. NUMBER: ORDINALS

Reinforce and/or develop ordinal numbers beyond twentieth.

Suggestions for Pupil Activities

Adapt the learning activities for Unit 3 and extend the use of ordinal terms. For example, read dates on a calendar as September twenty-eighth.

Additional Suggestions

Apply the use of ordinal terms when assigning numbers to points on a line. Discuss the points as first point, second point third point, etc.

Investigate where ordinal terms are used. Make a list and observe the various notations used to indicate ordinals.

Names of streets	Sixth Street	6th St.
Names of avenues	Second Avenue	2nd Ave.
Place of a team in a league	Rockets 3rd	
Place of a batter in a baseball team		
Innings of baseball games		
Etc.		

Discuss the relationship between the word symbol and the numeral term for ordinals by:

- Listing the word symbols

first second third fourth
fifth
sixth
seventh
eighth
ninth
tenth

- Associating the numeral 4 with fourth; 5 with fifth; and so on through tenth; 1 with first; 2 with second; 3 with third.

- Deriving another type of symbol by using the numeral and the last two letters of the word.

first	second	third	fourth
1st	2nd	3rd	4th

Make reference to the use of ordinal terms in daily classroom experiences. Whenever possible give directions using the terms, e.g., "The first child on each team may count the members of the team." Apply the concept of ordinal numbers when discussing the order of events shown in a group of pictures; when ordering events with respect to time. (See Unit 20)

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UNIT 13. ADDITION OF WHOLE NUMBERS

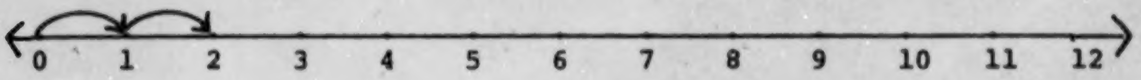
Reinforce basic facts, sums through 10.
Develop basic facts, sums 13 and 14.

Suggestions for Pupil Activities

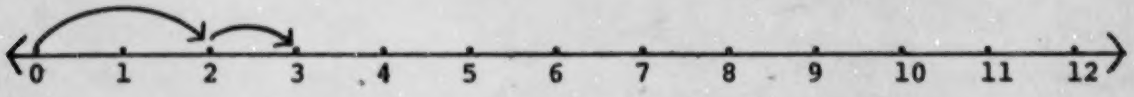
I. Review basic facts (Sums through 10)

- Develop a series of number lines or number rays that demonstrate adding 1 to a number. Give directions such as:

  Start at zero. Move 1 space. Name the stop.
  Move 1 more space. Name the stop.



  Start at zero. Move 2 spaces. Name the stop.
  Move 1 more space. Name the stop.



  Continue in sequence through: move 9, then move 1 more.

- Interpret the moves on the number lines in terms of these addition facts:

1 + 1 = 2
2 + 1 = 3
3 + 1 = 4
4 + 1 = 5
5 + 1 = 6
.
.
.
9 + 1 = 10

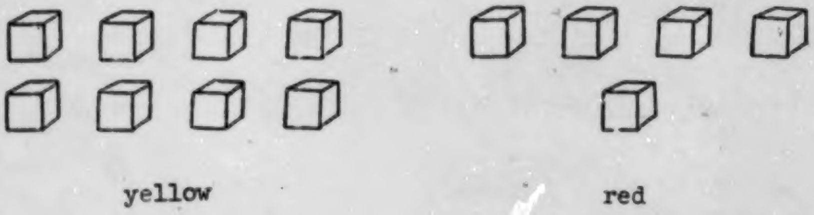
- Conclude: When 1 is added to a number the sum (answer) is the next number in ascending order.

II. Develop the basic facts with sums 13 and 14 by adapting the learning activities in Unit 9 II.

Additional Suggestions

Combine sets of objects and derive addition facts, sums 13 and 14.

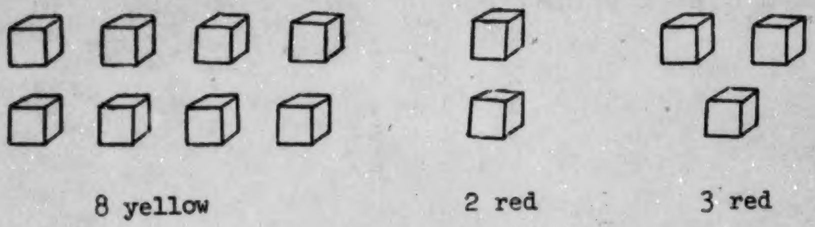
- Select 13 cubes of 2 different colors.



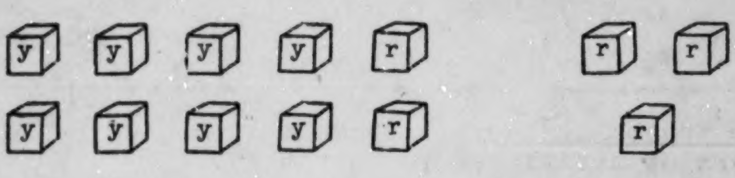
- Combine the sets of cubes.
How many cubes altogether? 8 + 5 = 13

- Restore the original 2 sets. Discuss the number of cubes needed with the group of 8 to make 10.

- Regroup objects so as to show 5 renamed as 2 + 3.



- Move the objects together and write the addition sentence.



(8 + 2) + 3 = 13
10 + 3 = 13

or

8 + (2 + 3)
8 + 5 = 13

Note: Parenthesis are used to indicate which pairs of numbers are added first.

- Record basic addition fact horizontally and vertically.

$$8 + 5 = 13 \qquad \begin{array}{r} 8 \\ +5 \\ \hline 13 \end{array}$$

- Similarly proceed with:

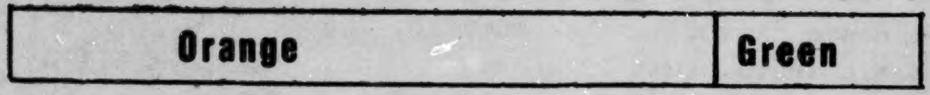
9 + 4 = 13
7 + 6 = 13

9 + 5 = 14
8 + 6 = 14
7 + 7 = 14

Experiment with colored rods to discover basic facts with the sums 13 and 14.

- Agree to assign the number name 1 to the white rod. Name the other rods accordingly in order, i.e., red = 2. (light) green = 3, purple = 4, and so on through orange = 10.

- Place the orange rod and the green rod end to end to represent 13.

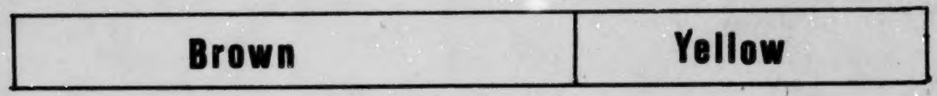


10 + 3 = 13

- Match the "13" rod with different pairs of rods which when placed end to end are as long as the orange plus the green rod.

- Keep a record of the different combinations for 13 by writing addition sentences to describe each way. For example:

7 + 6 = 13



8 + 5 = 13

- Record number combinations vertically.
- Observe and discuss the commutative property of addition.
- To discover basic facts for the sum 14 start with an orange plus purple rod.

**

UNIT 14. SUBTRACTION OF WHOLE NUMBERS

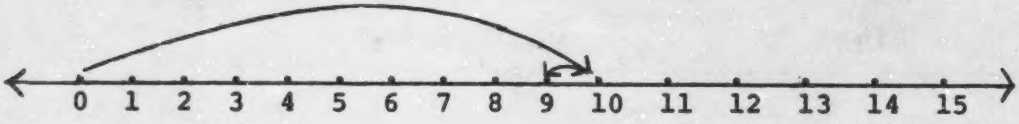
Reinforce basic facts, sums through 10.
Develop basic facts, sums 13 and 14.

Suggestions for Pupil Activities

I. Review basic facts (Sums through 10)

- Use a series of number lines or number rays to demonstrate subtracting 1; subtracting 2 from a number. Give directions such as:

  Start at zero. Move 10 spaces to the right.
  Name the stop. Move back (to the left) 1 space.
  Name the stop.



Continue in sequence through: move 1, then move 1 back.

- Generate a pattern of subtraction sentences such as:

  10 - 1 = 9
  9 - 1 = 8
  8 - 1 = 7
  7 - 1 = 6
  and so on to
  1 - 1 = 0

- Examine and discuss the pattern. Conclude that when 1 is subtracted from a number the result (answer) is the next number in descending order.

* Walk-on number lines are useful here.

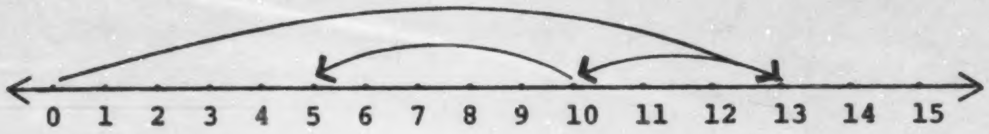
II. Develop the basic facts with sums 13 and 14 by adapting the learning activities in Unit 10, I and II.

Additional Suggestions

Use number lines or number rays to demonstrate "subtracting to ten first." (See Unit 10) Derive subtraction facts such as:

13 - 9 = 4   13 - 8 = 5   13 - 7 = 6   13 - 6 = 7
13 - 5 = 8   13 - 4 = 9   14 - 9 = 5   14 - 8 = 6
14 - 7 = 7   14 - 6 = 8   14 - 5 = 9

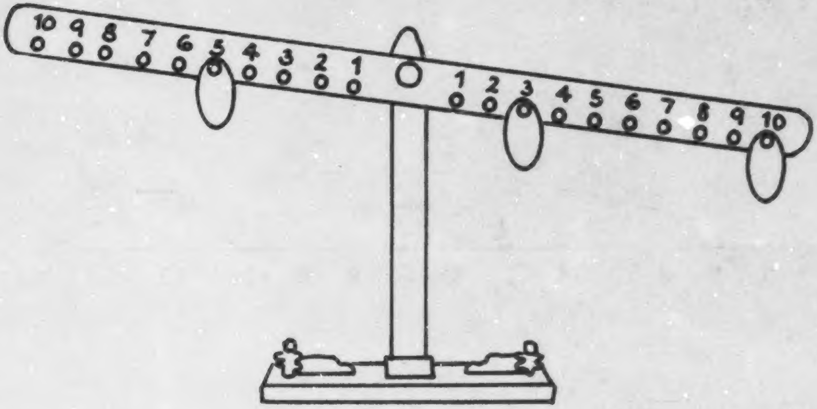
For: 13 - 8 = 5



Think: 13 - 3 = 10
To complete the subtraction move back 5 more spaces.
10 - 5 = 5   so   13 - 8 = 5

Demonstrate the missing addend concept on a mathematical balance using sums 13 and 14. Give directions such as:

- Place 2 weights on one side of the beam, one on 10 and another on 3.
- On the other side of the beam put one weight on 5.
- Discuss the position of the beam and ways of making it balance.



- Express the imbalance in terms of open sentences such as:

$$5 + \square = 3 + 10 \quad \text{or} \quad 5 + \square = 13$$

- On which peg of the left side should another weight be placed to make it balance?
- Complete the equation.

$$5 + \boxed{8} = 13$$

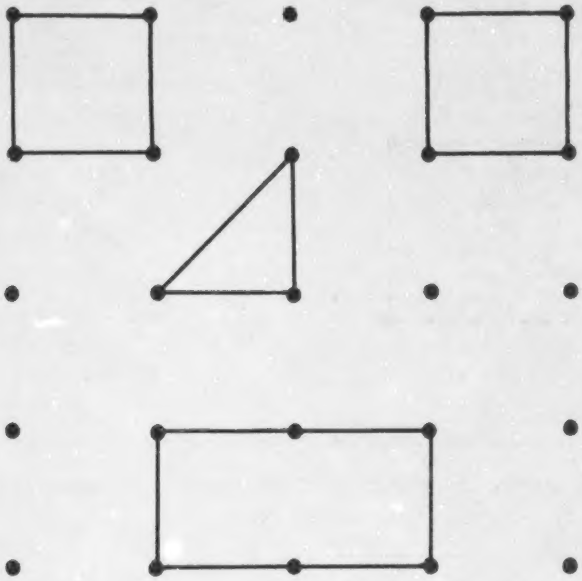
***

UNIT 15. GEOMETRY

Use a geoboard to reinforce and explore properties of geometric figures such as rectangle, square, triangle, circle.

Suggestions for Pupil Activities

Experiment with geoboard and rubber bands. Make "faces" using more than one rubber band.



Describe characteristics of each figure. Name the shapes. Make comparisons. Copy shapes on dot paper.

Use materials such as straws, pipe cleaners, wire, and tinker toys to explore models of plane figures.

Through discussion and questioning elicit ideas such as:

the sides of the models represent line segments

the line segments of these figures do not cross themselves

the names of the figures - triangle, square, rectangle

72

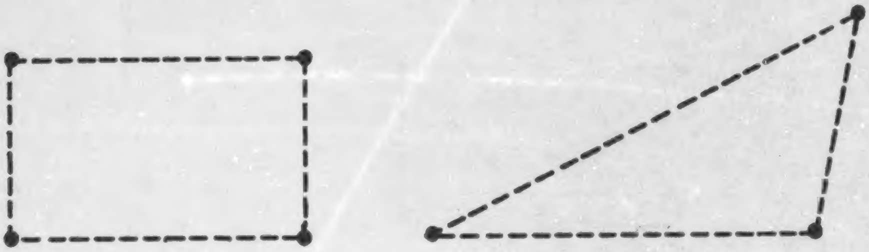
the rectangle has 4 square corners, 4 line segments

the triangle has 3 corners, 3 line segments

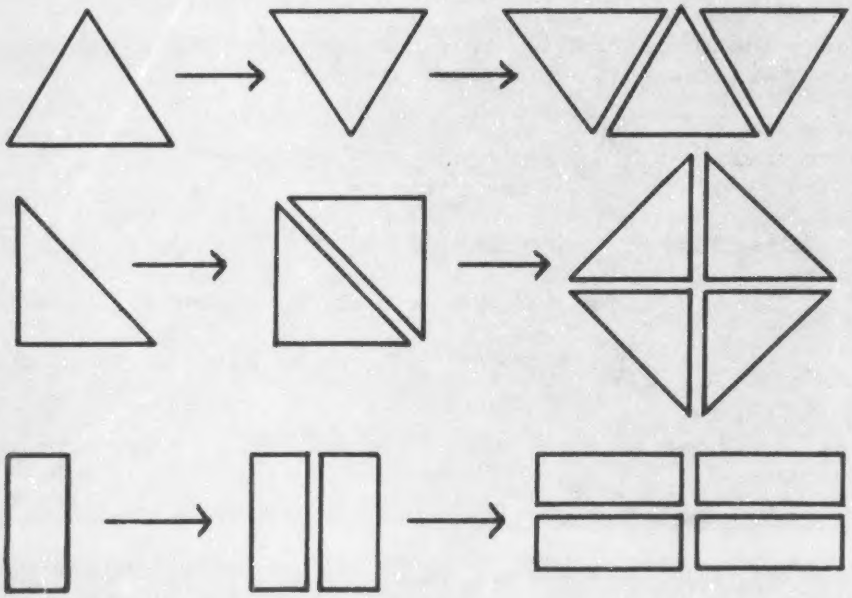
the square has 4 line segments that are the same length

the circle has no corners

Make plane figures by punching holes in paper. Connect points with line segments.



Experiment with geo-blocks or sets of geometric figures made from cardboard to form new shapes. Discuss characteristics of shapes.



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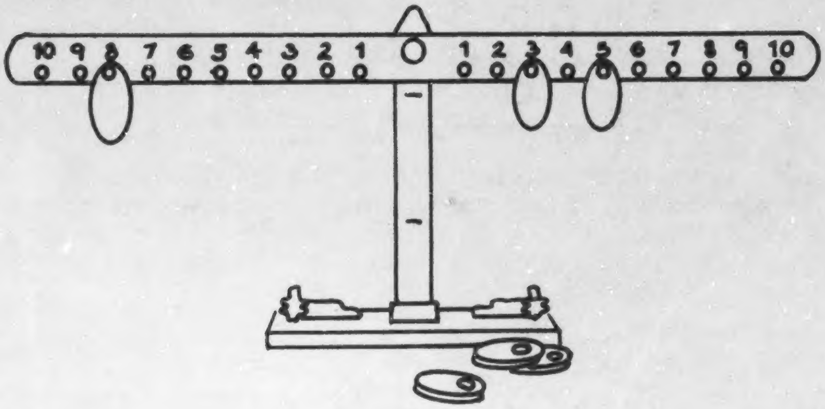
UNIT 16. ADDITION OF WHOLE NUMBERS

Reinforce basic facts, sums through 14.
Develop: basic facts, sums 15,16,17,18 column addition (more than two addends) sums through 18.

Suggestions for Pupil Activities

I. Name sums through 14 by using a mathematical balance.



Direct as follows:

- Put a weight on the peg for the numeral 8 on the left side of the beam.
- Place weights on the right side so as to balance the beam.
- Find as many different ways as you can to balance 8. Write number sentences that describe each way.

Left Side		Right Side
8	=	5 + 3
8	=	8
8	=	7 + 1
8	=	2 fours
8	=	5 + 2 + 1

etc.

- Try balancing 4,5,6....14
  Hint: show 11 on one side of the beam by placing 1 weight on 10 and another weight on 1.
  Possible recordings would be:

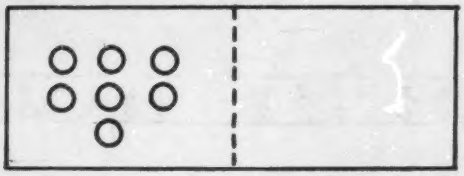
$10 + 1 = 9 + 2$
$10 + 1 = 8 + 3$
$10 + 1 = 4 + 5 + 2$

II. **Develop the basic facts, sums 15,16,17 and 18 by adapting the activities in Units 9 and 13.**

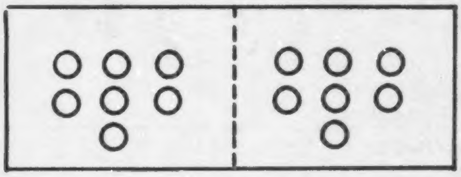
Additional Suggestions

Use the double and near-double relationship to derive basic facts.

- **Form a double by placing 7 discs on one side of a piece of paper which is folded in half.**



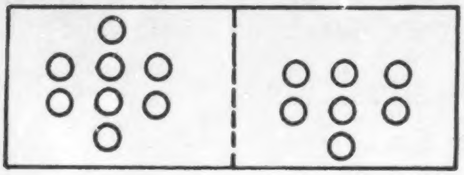
Discuss ways of doubling the group of 7.
Place another 7 discs on the paper and write the addition fact.



7 + 7 = 14

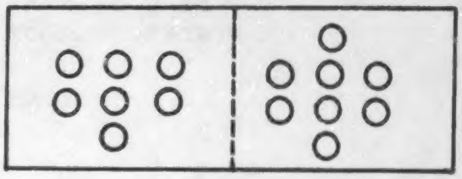
- **Examine the double and discuss ways of showing 15 discs. Write the addition fact for each way.**

Put 1 disc here



Write: 8 + 7 = 15

Put 1 disc here



Write: 7 + 8 = 15

- **Compare**

$\begin{array}{r} 7 \\ +7 \\ \hline 14 \end{array}$ **with** $\begin{array}{r} 8 \\ +7 \\ \hline 15 \end{array}$

$\begin{array}{r} 7 \\ +7 \\ \hline 14 \end{array}$ **with** $\begin{array}{r} 7 \\ +8 \\ \hline 15 \end{array}$

- Conclude:

  7 + 8 is one more than 7 + 7
  8 + 7 is one less than 8 + 8

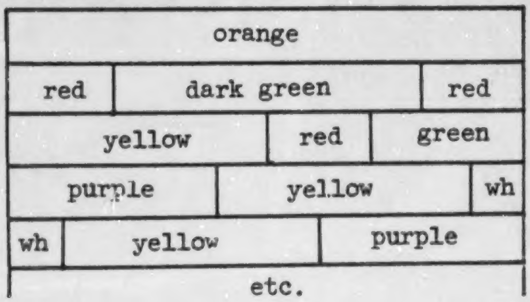
Similarly derive:

8 + 8 = 16 8 + 9 = 17 9 + 9 = 18

Explore addition with more than two addends through the use of colored rods, interlocking cubes, 1-inch cubic blocks, bead frame or other similar materials.

For the sum 10

- Assign a number value to each colored rod when the white rod is 1.
- Select an orange rod. (10 rod)
- Match the orange rod with three or more rods which when placed end to end are as long as the orange rod. Form many different arrangements.
- Interpret each row of rods in terms of an addition sentence.



2 + 6 + 2 = 10
5 + 2 + 3 = 10
4 + 5 + 1 = 10
1 + 5 + 4 = 10
etc.

- Record the sentences in vertical form and relate them to the horizontal form.

$$\begin{array}{r} 5 \\ 2 \\ +3 \\ \hline 10 \end{array} \quad \text{is the same as} \quad 5 + 2 + 3 = 10$$

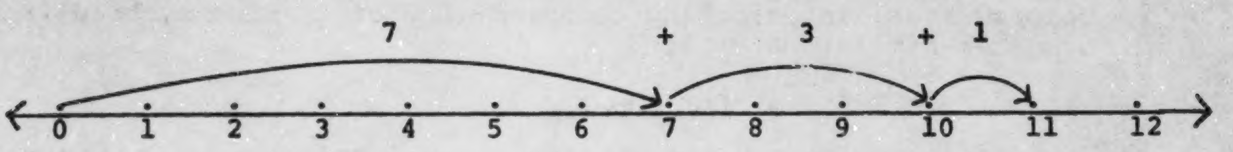
- Discuss ways of adding 3 or more addends.

$$\begin{array}{rl} 5 & \text{think:} \\ 2 & \text{7 plus 3 is 10} \\ +3 & \\ \hline 10 & \end{array} \qquad \begin{array}{rl} 5 & \text{think:} \\ 2 & \text{5 plus 5 is 10} \\ +3 & \\ \hline 10 & \end{array}$$

Note: This method is an application of the associative property of addition which states that the way addends are grouped does not affect the sum.

Demonstrate adding 3 or more numbers on a number line.

- Present 7 + 3 + 1 =
- Represent each addend as a move on a number line.



- Think: 7 plus 3 is 10; 10 plus 1 is 11 so 7 + 3 + 1 = 11
- Place parenthesis around the 2 numbers added first.

  (7+3) + 1 = 11

- Demonstrate that the sum is the same when the numbers 1 and 3 are added first.

**

UNIT 17. SUBTRACTION OF WHOLE NUMBERS

Reinforce basic facts, sums through 14.
Develop basic facts, sums 15, 16, 17 and 18.

Suggestions for Pupil Activities

I. Engage in games such as, Guess The Rule, to review basic subtraction facts.

- The teacher thinks of a rule, e.g., subtract 2.
- The pupils give □ numbers. The teacher gives △ numbers. Limit □ numbers to numbers greater than 1.
- Complete a table according to the rule.

□	△
4	2
3	1
11	9

etc.

- Discuss the relationship between □ numbers and △ numbers and the rule used to derive the △ numbers.
- Derive an open sentence that fits all cases, e.g., □ - 2 =△
- Use the number pairs on the chart to make the open sentence true, e.g., 4 - 2 = 2

II. Develop the basic facts with the sums 15, 16, 17 and 18 by adapting the learning activities in Units 10 and 14.

Additional Suggestions

Demonstrate subtraction facts in terms of open sentences of the type $15 - \square = 9$. Use beads on a frame, discs, interlocking cubes, geometric shapes, or other similar materials.

Give directions as follows:

- Take 15 discs.
- Take away enough discs so that 9 discs are left.
- How many discs are removed?
- Express the action as, $15 - \square = 9$ and read: "15 minus what number equals 9?"
- Complete the open sentence.
- Repeat for $15 - \square = 6$ $15 - \square = 8$ $15 - \square = 7$, etc.

****

UNIT 18. PROBLEM SOLVING

Express problems in mathematical sentences.

Suggestions for Pupil Activities

Use story problems developed from classroom experiences.

There are 7 round-shaped blocks in the box.

The teacher puts 8 round-shaped blocks into the box.

How many round-shaped blocks are in the box altogether?

Have children:

dramatize the word problem

restate the problem in their own words

explore ways of answering the question

determine operation needed to solve the problem

tell or write an open sentence that fits the story $7 + 8 = \square$

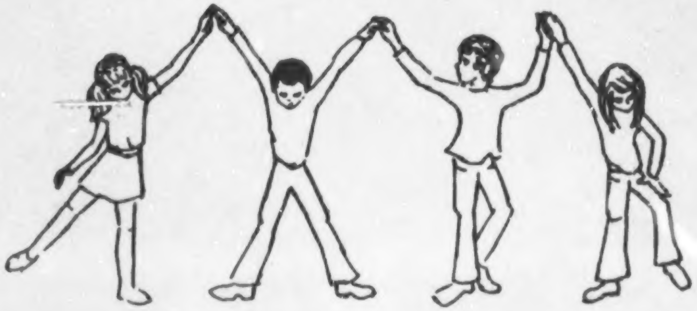
or $8 + 7 = \square$

complete the open sentence

interpret the solution in terms of the question

Use pictures that suggest combining groups of people or things.

(Flannel board materials could be used here)



Discuss:

action in the picture

a number story that fits the picture

a number sentence that can be related to the situation

ways of solving the problem

In a similar way discuss pictures that suggest a small group being removed from the larger group.

Encourage partners to create original word problems.

Direct as follows:

Pupil A - Selects two numbers, 8 and 13

Pupil B - Tells and/or writes a number story using the two numbers, e.g.

There are 13 boys in our class. Only 8 boys are here today. How many boys are absent?

Initiate a class discussion to reinforce problem solving techniques by recording the original problem on newsprint. Include the name of the pupils who suggested the number story.

Create a collection of pupils' problems and refer to them throughout the school year.

UNIT 19. NUMBER: FRACTIONAL NUMBERS

Reinforce and/or develop:

- the concept of one-half
- renaming wholes and halves in fraction form and as mixed numerals

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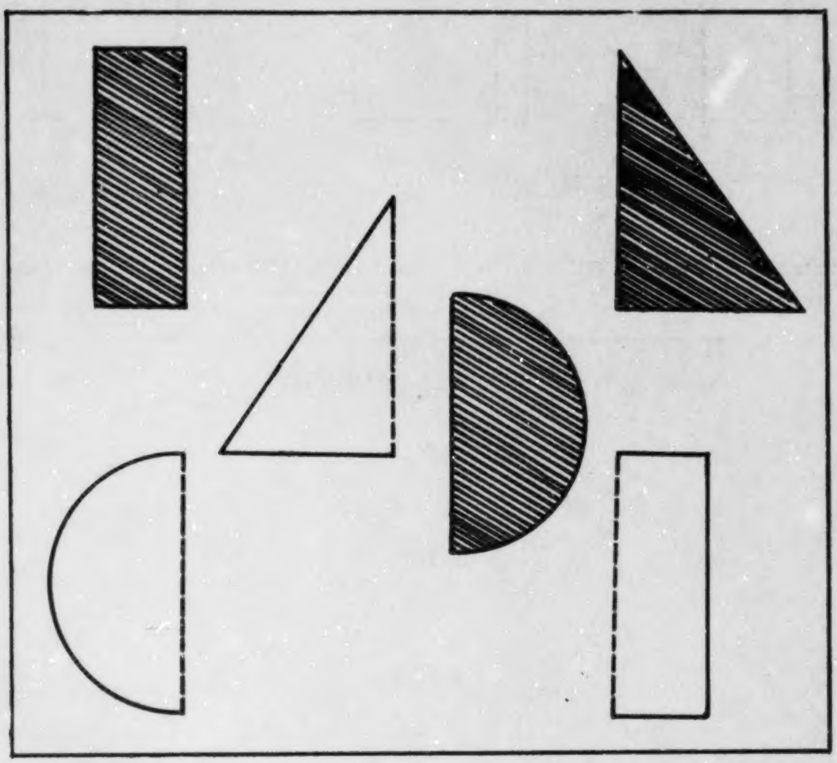
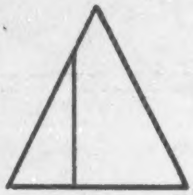
Suggestions for Pupil Activities

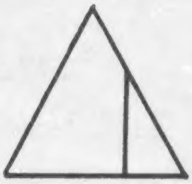
Assess the children's ability to recognize one half by:

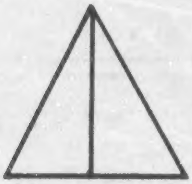
- matching a collection of halves made out of construction paper.

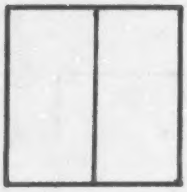


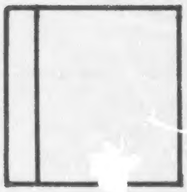
- Selecting geometric figures that show halves.
  Which show halves?

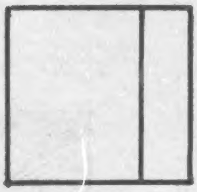








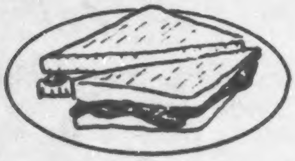


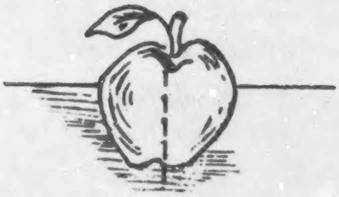


- finding pictures of halves in magazines or newspapers.

Teacher's Notes

Explore ways of dividing various objects into two parts of the same size.





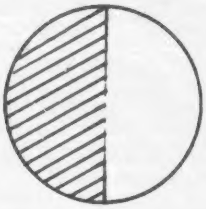
1 sandwich to share.
Are both parts the same size?
What part of the whole sandwich is each piece?
Each piece is one half of the whole sandwich.

1 apple to share.
2 parts of the same size.
Each part is one half of the apple.
The symbols 1/2 and one-half name each part.

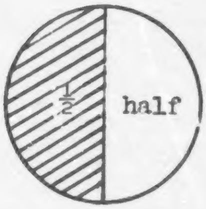
Use paper circles, squares and equilateral triangles.

Direct as follows:

- Fold a circle in half.



- Name each part.



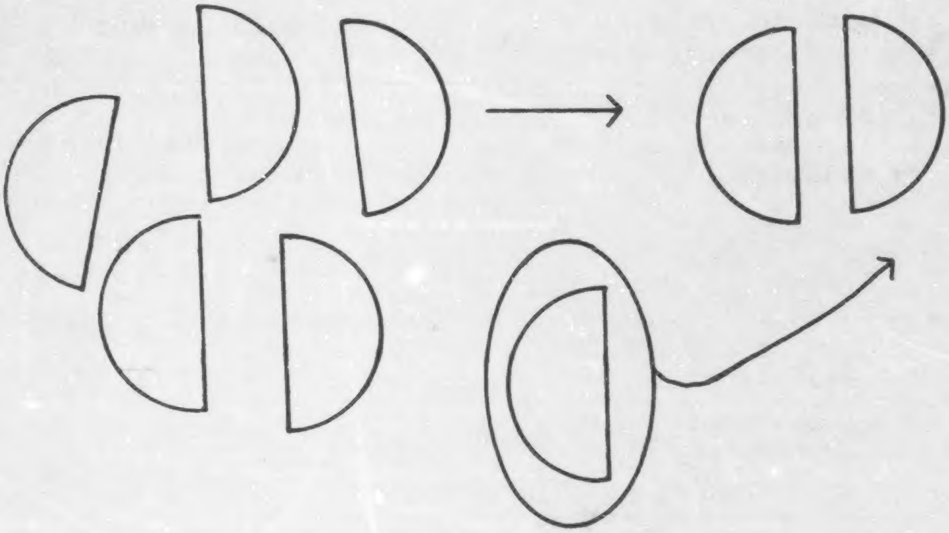
- How many halves in the whole circle?

1 half + 1 half = 2 halves or 1 whole.
1/2 + 1/2 = 2/2 or 1

Use paper cutouts of halves to explore counting by halves.

Direct as follows:

- Move the halves one at a time and name the number: one-half, two halves, three halves, etc.



- Record the counting in various ways.

1/2, 2/2, 3/2, 4/2, 5/2, etc.
or
1/2, 1, 1 and 1/2, 2, 2 and 1/2, 3, etc.
or
1/2, 1, 1-1/2, 2, 2-1/2, etc.

***

UNIT 20. MEASUREMENT: TIME: CLOCK

Reinforce and/or develop the concepts of hour and half-hour. Emphasize telling time to the hour and to the half-hour.

Suggestions for Pupil Activities

NOTE: This unit should be considered a beginning for the study of telling time. Work in this topic should continue throughout the year by referring to a clock at every opportunity during the school day.

Encourage growth in "time sense."

- Make a clock by using two candles of the same size. Light one candle and allow it to burn for one hour. Keep a record of classroom activities carried on during that time. Note the amount of candle burned and mark one hour sections on the second candle. Discuss "How long is 1 hour?"

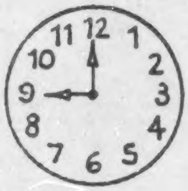
- Initiate discussions about:

  Can you walk to school in 1 hour?
  Can you eat lunch in 1 hour?
  Do you sleep for more or less than 1 hour at night?
  What tasks can you do in 1 hour?
  How many blocks do you think you can walk in 1 hour?

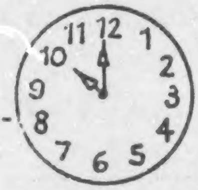
Teacher's Notes

Use a real clock, a demonstration clock and/or individual clock faces to relate telling time on the hour to school activities; out-of-school activities.

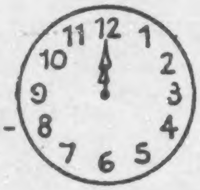
School day begins--------------------



Go to the library--------------------



Lunch time---------------------------



etc.

- Examine the clock faces and observe:

  12 numerals
  arrangement of the numerals
  2 hands and their lengths
  the position of each hand at 9 o'clock;
  10 o'clock; 12 o'clock, etc.

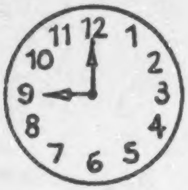
- Generalize that when the long hand is at 12, the short hand points to the numeral that names the hours.

- Describe the position of both hands at the next hour.

Relate telling time on the half-hour to telling time on the hour.

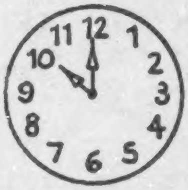
Set an alarm clock at 9 o'clock. Record the time showing and note the position of both hands. Set the alarm to ring 1 hour later. When the alarm rings, note the position of the hands and record 10 o'clock.

9 o'clock



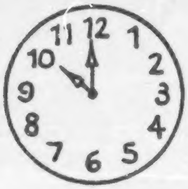
1 hour later

10 o'clock



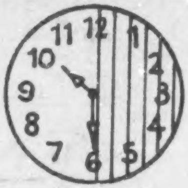
Note the position of the hands at 10 o'clock and reset the alarm to ring one-half hour later.

10 o'clock



1 half-hour later

half past 10



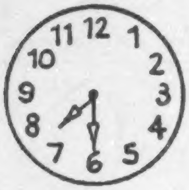
Examine the clock faces and discuss:

- location of both hands when it is time on the hour.
- location of the long hand when it is half past the hour.
- location of the short hand when it is half past the hour. (it is halfway between 10 and 11)
- the movement of the long hand from 12 to 6 as having moved halfway around the clock.
- the appropriateness of the term "half-hour".

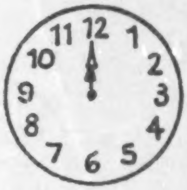
Investigate other half-hour intervals by relating them to hours around the clock.

Prepare sets of clock faces to show the hour and/or the half-hour for such daily events as getting up in the morning, leaving for school, having lunch, going home, having dinner, watching T.V., doing homework or whatever the class decides.

I get up



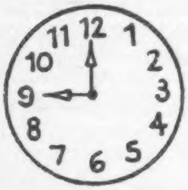
Time for lunch



Arrange the clock faces in sequence beginning with morning activities. Find out which classmate got up the earliest; stayed up the latest.

Solve time problems. Use demonstration clocks, real clocks and/or individual clock faces.

It is now



We will go to the yard 1 hour from now; 1 half-hour from now; 2 hours from now; etc.

It will be

Set pairs of clock faces to demonstrate concepts of earlier; later.

A				B
3 o'clock	→	1 hour earlier	→	2 o'clock
1 o'clock	→	2 hours later	→	3 o'clock
4 o'clock	→	1 half-hour later	→	half past 4
half past 2	→	1 half-hour earlier	→	2 o'clock

**

UNIT 21. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

Apply the principle of related operations to reinforce basic addition and subtraction facts.

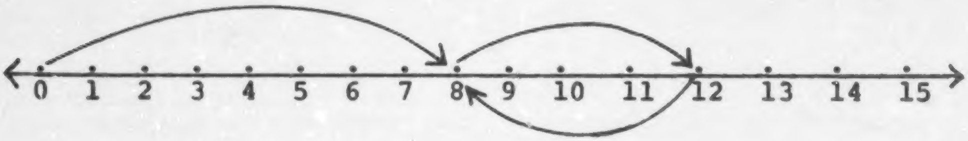
Suggestions for Pupil Activities

Refer to Unit 10 for activities which emphasize the objective of this unit.

Additional Suggestions

Demonstrate pairs of related addition and subtraction facts by using walk-on number lines or chalkboard representation.

- Derive 8 + 4 = 12 by making moves along a number line from zero.



- Start at the sum 12 and move back 4 spaces. Name the stop number.
- Describe the "move back" as a subtraction sentence, e.g., 12 - 4 = 8.
- **Conclude 8 + 4 = 12 so 12 - 4 = 8**
- **Repeat for: 4 + 8 = 12 so 12 - 8 = 4**
  6 + 7 = 13 so 13 - 7 = 6
  8 + 6 = 14 so 14 - 6 = 8

Use colored rods to derive the related subtraction facts for an addition fact. Direct as follows:

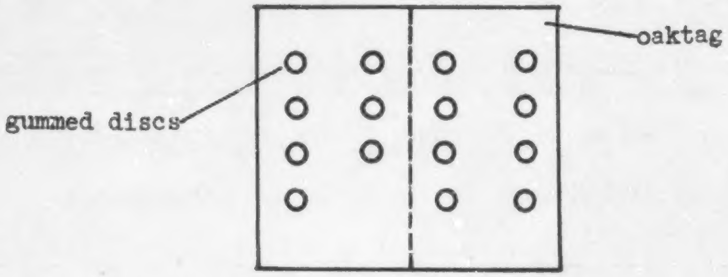
- Let the white rod equal 1 and assign number names to the other rods accordingly, e.g., red = 2, green = 3, etc.
- Set up a combination of two rods for the sum 15. Write an addition sentence.

- Agree that the blue rod and dark green rod is a model of the sum 15.
- Remove one rod and write a subtraction sentence to describe the action.

- Conclude 9 + 6 = 15 so 15 - 6 = 9
- Repeat for: 6 + 9 = 15 so 15 - 9 = 6

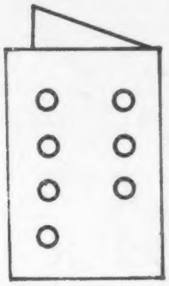
Engage in making sets of spot cards which show different combinations of the sums through 18. Use the cards to derive related addition and subtraction facts.

- **Show both sides at once and write two addition sentences.**



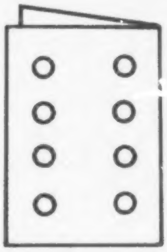
7 + 8 = 15 8 + 7 = 15

- **Fold back one side and write the subtraction sentence that describes the action.**



15 - 8 = 7

- **Show both sides again. Then fold back the other side. Write the related subtraction fact.**



15 - 7 = 8

- **Organize the "family" of facts.**

7 + 8 = 15 so 15 - 8 = 7
8 + 7 = 15 so 15 - 7 = 8

*

UNIT 22. NUMBER — NUMERATION

Continue to develop place value concepts involving the numbers 11 through 99. Record numerals in expanded and standard forms,
e.g., 73 = 7 tens + 3 ones
73 = 70 + 3

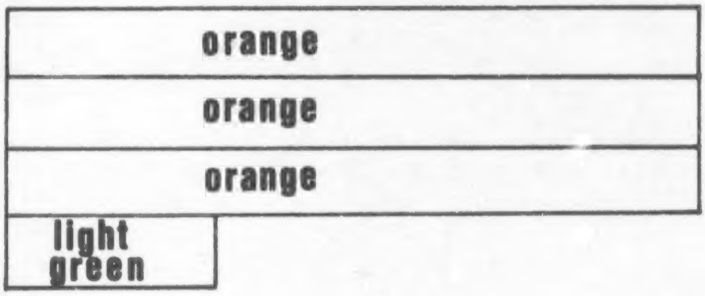
Suggestions for Pupil Activities

Adapt learning activities in Unit 6A to extend place value concepts.

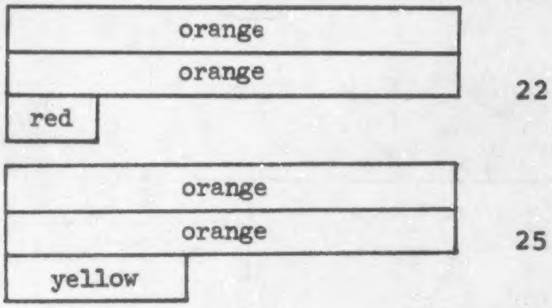
Additional Suggestions

Investigate place value concepts with colored rods.

- Find out how many white rods cover each of the other 9 colored rods. For example, 2 white rods cover the red rod; 3 white rods cover the light green rod.
- Assign number names to each of the 10 colored rods when the white rod is 1. Which rod is 10? (Orange)
- Now use the rods to show the numbers 11 through 99.



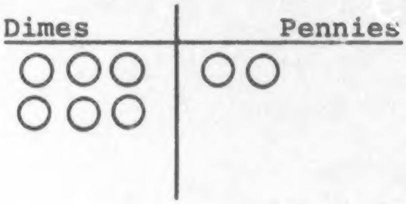
- Compare two models of the numbers and tell which number is greater (less). Write mathematical sentences to describe the relationship.



$22 < 25$ $25 > 22$

Show the place value meaning of the numbers 11 - 99 with:

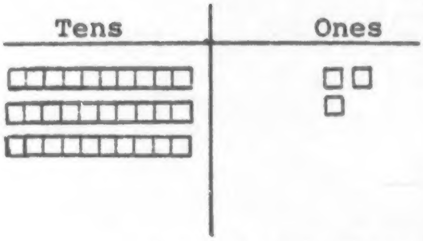
- Coins



6 dimes + 2 pennies

60¢ + 2¢ = 62¢

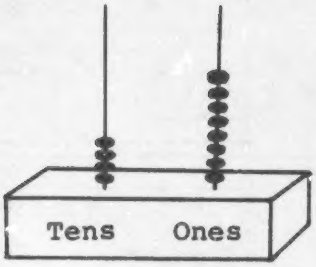
- Squared Material



3 tens + 3 ones

30 + 3 = 33

- **Abacus**



4 tens + 8 ones

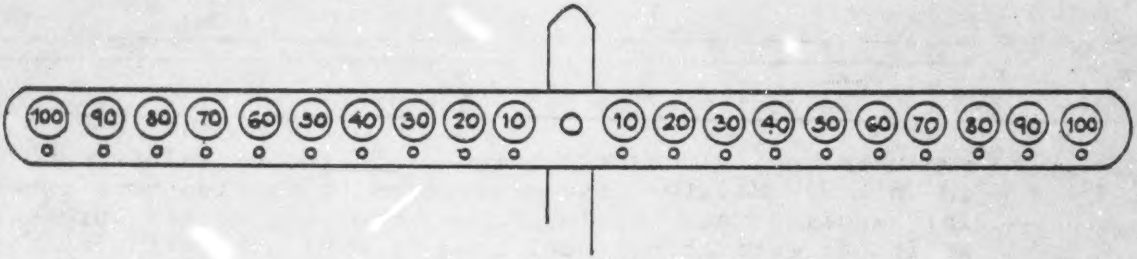
40 + 8 = 48

For each number represented discuss the meaning of each digit in the standard numeral. For example, in 48 the digit 4 means 40 or 4 tens, the digit 8 means 8 ones or 8.

Teacher's Notes

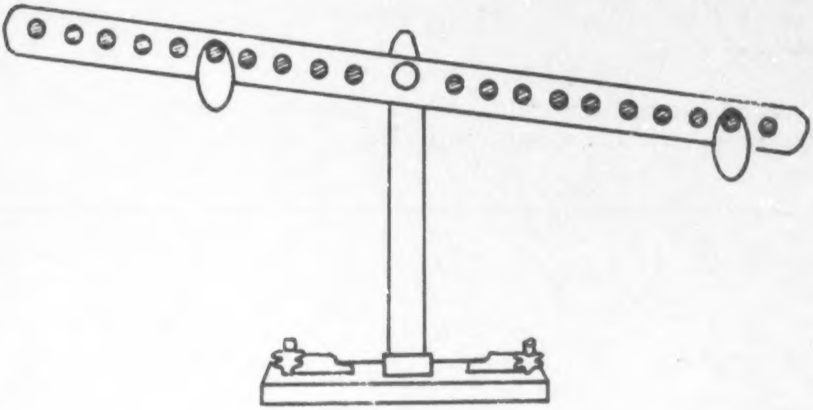
Use a mathematical balance to make number comparisons.

- Label the arm of the balance beam in the number sequence indicated below.



- Recall the analogy of imbalance on the scale with the inequality symbols (<, >) used in a mathematical sentence. (See Unit 2)

- Place 1 weight on 90 on the right side of the scale. Place 1 weight on 50 on the left side of the scale. What happens? Write a mathematical sentence using relation symbols or words that describes the position of the scale.



$50 < 90$ or $90 > 50$

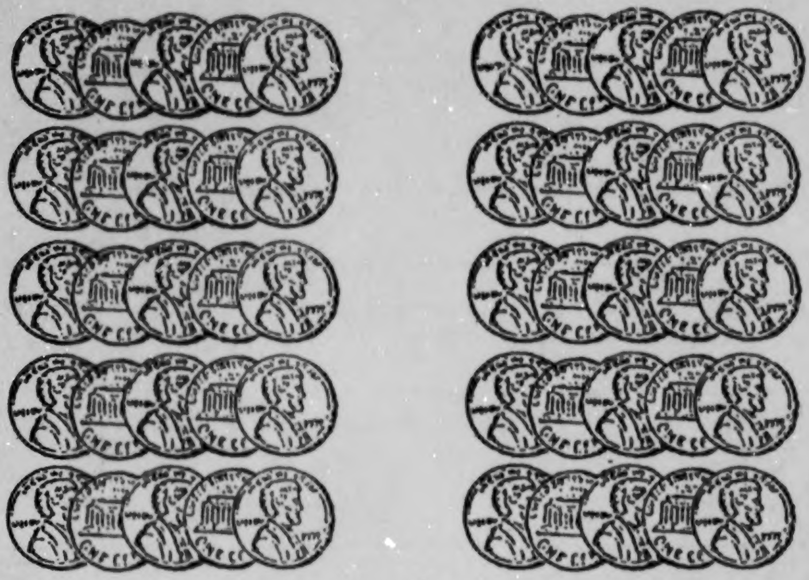
50 is less than 90 90 is greater than 50

- Place weights on pegs to show other numbers that are greater than 30. Write number sentences.

- Place weights on pegs to show the numbers that are less than 30. Write number sentences.

Additional Suggestions

Adapt the development in Unit 7 to investigate collecting of coins equivalent in value to a half-dollar.



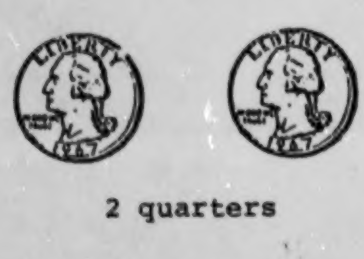
50 pennies

5 dimes

1 half dollar

50¢

10 nickels



2 quarters

Summarize the results on a chart.

Coins	Value
50 pennies	50¢
5 dimes	50¢
10 nickels	50¢
2 quarters	50¢

Discuss the advantages and disadantages of a single coin.

Work with real or play coins and investigate combinations that are equivalent in value to given amounts of money.

Half Dollars	Quarters	Dimes	Nickels	Pennies	Amount

Compare pupils' charts and discuss the different combinations for the same amount of money.

Use collections of coins to demonstrate a procedure for making change.

- A 16¢ purchase is made with a quarter.
- Count out various coins from 16¢ to 25¢ as with:

    pennies and nickels - 17, 18, 19, 20, 25

    pennies - 17, 18, 19, 20, 21, 22, 23, 24, 25

Investigate other ways of making change.

Make lists of articles that can be bought for specific amounts of money less than 1 dollar.

**

UNIT 24. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

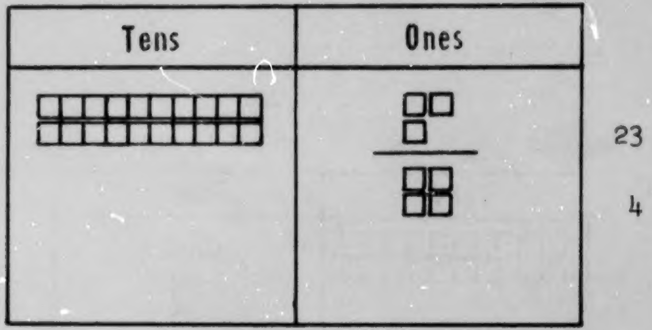
Develop addition of two numbers, one expressed by a 2-digit numeral and the other expressed by a 1-digit numeral, no exchange. Use vertical and/or horizontal forms.

Suggestions for Pupil Activities

Explore ways of computing sums and differences with no exchange (regrouping). Use squared materials, place value charts, dimes and pennies, multibase arithmetic blocks or other place value materials.

A. Additions of the type $\begin{array}{r} 23 \\ +\ 4 \\ \hline \end{array}$

- Represent each addend with squared materials.



- Discuss various ways of finding the total number or the sum represented. What is the sum?

- Develop a place value form that matches the squared materials shown.

$$\begin{array}{r} 2 \text{ tens} + 3 \text{ ones} \\ + \qquad\quad 4 \text{ ones} \\ \hline 2 \text{ tens} + 7 \text{ ones} \end{array}$$

or

Tens	Ones
2	3
+	4
2	7

- Give the standard numeral for the sum expressed as as 2 tens + 7 ones. (See Units 6 and 22)

- Develop the standard form from the place value form.

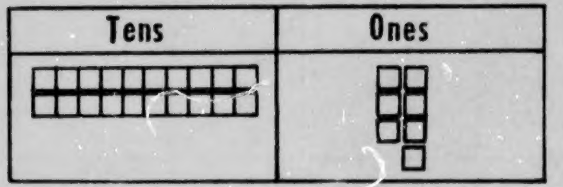
$$\begin{array}{r} 2 \text{ tens} + 3 \text{ ones} \\ + \qquad\quad 4 \text{ ones} \\ \hline 2 \text{ tens} + 7 \text{ ones} \end{array} \qquad \begin{array}{r} 23 \\ +\ 4 \\ \hline 27 \end{array}$$

Add the ones
Record the 7
Add the tens
Record the 2

- Verify with the squared materials that 2 tens + 7 ones and 27 name the same number.

B. Subtractions of the type $\begin{array}{r} 27 \\ -\ 4 \\ \hline \end{array}$

- Represent 27 with squared materials.



27

- Discuss minus 4 in terms of removing that many unit squares or ones. What is left? What is 27 minus 4?

$$\begin{array}{r} 2 \text{ tens} + 7 \text{ ones} \\ - \qquad\quad 4 \text{ ones} \\ \hline 2 \text{ tens} + 3 \text{ ones} \end{array}$$

or

Tens	Ones
2	7
−	4
2	3

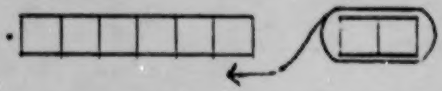
- Give the standard numeral for the difference (answer) expressed as 2 tens + 3 ones. (See Units 6 and 22)

- Develop the standard form from the place value form.

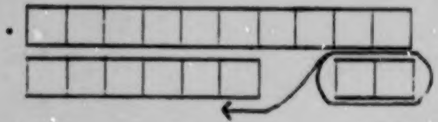
2 tens + 7 ones	27	Subtract the ones
− 4 ones	− 4	Record the 3
2 tens + 3 ones	23	Subtract the tens Record the 2

Find sums by exploring patterns. Use squared materials, interlocking cubes or individual bead frames.

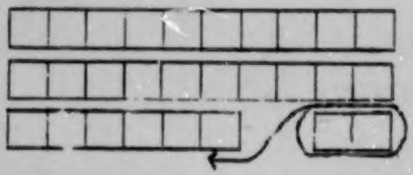
Show **Add** **Record**



6 + 2 = 8



16 + 2 = 18

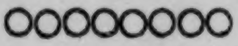


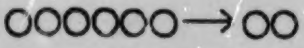
26 + 2 = 28

Examine the pattern and discuss the use of the basic fact 6 + 2 = 8 as an aid in naming greater sums.

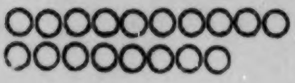
Compute differences by exploring patterns. The illustrations here show the use of individual bead frames with ten rows of beads, 10 beads in a row.

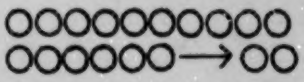
Show — **Note**

- 8 

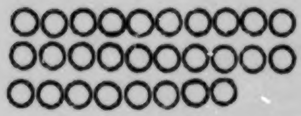
  move back 2 

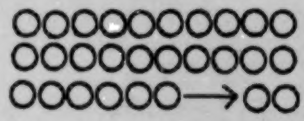
  8 - 2 = 6

- 18 

  move back 2 

  18 - 2 = 16

- 28 

  move back 2 

  28 - 2 = 26

- Continue to — 98 - 2 = 96

Examine the pattern and discuss the use of the basic fact 8 - 2 = 6 as an aid in naming differences. Recording could be done in vertical form, for example:

$$\begin{array}{cccccccc} 8 & 18 & 28 & 38 & 48 & & 98 \\ -2 & -\ 2 & -\ 2 & -\ 2 & -\ 2 & \cdots\cdot & -\ 2 \\ \hline 6 & 16 & 26 & 36 & 46 & & 96 \end{array}$$

Use the forms suggested in this unit to compute sums and differences such as:

$$\begin{array}{r} 15 \\ +\ 4 \\ \hline \end{array} \qquad \begin{array}{r} 25 \\ +\ 4 \\ \hline \end{array} \qquad \begin{array}{r} 37 \\ +\ 2 \\ \hline \end{array} \qquad \begin{array}{r} 45 \\ +\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 62 \\ +\ 5 \\ \hline \end{array}$$

$$\begin{array}{r} 26 \\ -\ 4 \\ \hline \end{array} \qquad \begin{array}{r} 34 \\ -\ 2 \\ \hline \end{array} \qquad \begin{array}{r} 48 \\ -\ 5 \\ \hline \end{array} \qquad \begin{array}{r} 59 \\ -\ 7 \\ \hline \end{array} \qquad \begin{array}{r} 89 \\ -\ 6 \\ \hline \end{array}$$

**

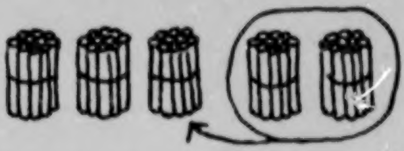
UNIT 25. ADDITION OF WHOLE NUMBERS

Develop adding ten and multiples of ten to numbers through 99.

Suggestions for Pupil Activities

Use bundles of ten, squared materials, interlocking cubes, multibase arithmetic blocks or other similar objects to explore ways of computing sums of the type $\begin{array}{r}30\\+20\\\hline\end{array}$

- Relate joining bundles of ten to adding tens. Write number sentences that describe the representations.



3 tens + 2 tens = 5 tens

- Rename 3 tens + 2 tens = 5 tens as:

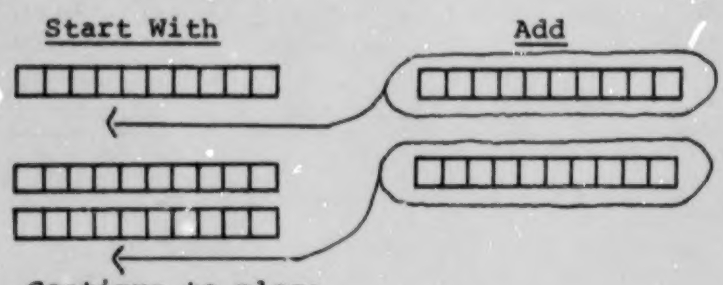
  30 + 20 = 50

  (See Unit 6 B)

- Show adding multiples of ten in vertical form.

3 tens	rename as	30
+2 tens	rename as	+20
5 tens	rename as	50

Add ten and multiples of ten by exploring patterns. Use squared materials, beads, colored rods, interolocking cubes, or other similar material.



Record

10 + 10 = 20

20 + 10 = 30

- Continue to place 1 more ten-strip until 9 tens + 1 ten is shown.

90 + 10 = 100

Discuss the pattern and count by tens to verify the sums.

Note: The ideas in Unit 27 may be developed together with this unit by using the principle of inverse operations.

**

UNIT 26. ADDITION OF WHOLE NUMBERS

Develop addition of numbers named by 2-digit numerals with no exchange (regrouping).

Suggestions for Pupil Activities

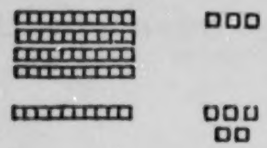
Use squared material, dimes and pennies, colored rods, multibase arithmetic blocks and other place value materials to explore ways of computing sums with no exchange.

For additions of the type

$$\begin{array}{r} 43 \\ +15 \\ \hline \end{array}$$

Method I

Show



Relate to Place Value Form		Standard Form	
4 tens + 3 ones		43	add the ones Record the 8
+ 1 ten + 5 ones		+15	Add the tens
5 tens +8 ones	=	58	Record the 5

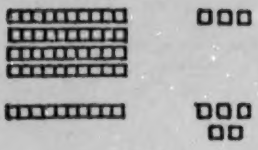
Refer to the materials and compute the sum for each form (algorithm).

Discuss: How many tens altogether?
How many ones are there?
What is 5 tens + 8 ones?
What is 43 plus 15?

107

Method II

Show



Relate to:
Expanded Form / **Standard Form**

$$\begin{array}{r} 40 + 3 \\ +\ 10 + 5 \\ \hline 50 + 8 \end{array} \quad = \quad \begin{array}{r} 43 \\ +\ 15 \\ \hline 58 \end{array}$$

Add the ones
Record the 8
Add the tens
Record the 5

Refer to the materials and compute the sum for each form.

Discuss: What is 40 plus 10?
What is 3 plus 5?
What is 50 plus 8?
What is 43 plus 15?

Verify with squared materials that 50 + 8 and 58 name the same number. (See Units 6 and 22)

Use the forms suggested in this unit to compute sums such as:

$$\begin{array}{r} 12 \\ +23 \\ \hline \end{array} \quad \begin{array}{r} 21 \\ +36 \\ \hline \end{array} \quad \begin{array}{r} 34 \\ +52 \\ \hline \end{array} \quad \begin{array}{r} 45 \\ +30 \\ \hline \end{array} \quad \begin{array}{r} 82 \\ +17 \\ \hline \end{array}$$

Treat units 24, 26 and 42 as topics for on-going study throughout the year. Provide homework assignments, games, practice exercises and other similar activities which will deepen each pupil's understanding of these addition skills.

**

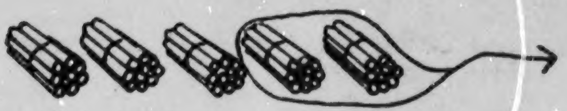
UNIT 27. SUBTRACTION OF WHOLE NUMBERS

Develop subtracting ten and multiples of ten from numbers through 99.

Suggestions for Pupil Activities

Use bundles of ten, squared materials, interlocking cubes, multibase arithmetic blocks or other similar objects to explore ways of computing differences of the type $\begin{array}{r} 50 \\ -20 \\ \hline \end{array}$

- Relate removing bundles of ten to subtracting tens. Write number sentences that describe the action.



5 tens - 2 tens = 3 tens

- Rename 5 tens - 2 tens = 3 tens as:

  50 - 20 = 30

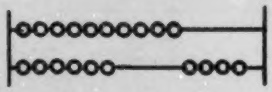
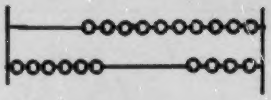
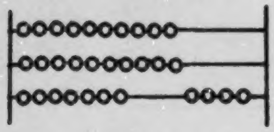
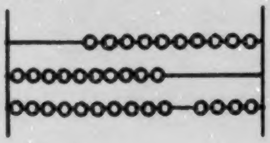
  (See Unit 6B)

- Demonstrate subtracting multiples of ten in vertical form.

$$\begin{array}{r} 5 \text{ tens} \\ - 2 \text{ tens} \\ \hline 3 \text{ tens} \end{array} \quad \begin{array}{l} \text{rename as} \\ \text{rename as} \\ \\ \text{rename as} \end{array} \quad \begin{array}{r} 50 \\ - 20 \\ \hline 30 \end{array}$$

109

Subtract ten and multiples of ten by exploring patterns. Use squared materials, colored rods, beads on a frame, interlocking cubes, or other similar material.

	Show	Slide Back	Note
.			16 - 10 = 6
.			26 - 10 = 16
.	Continue with 36, 46, 56, 66, 76, 86, 96		96 - 10 = 86

Discuss the pattern and count by tens to verify the difference.

Note: The concepts in Unit 25 may be developed and/or reinforced together with this unit by using the principle of inverse operations.

**

UNIT 28. SUBTRACTION OF WHOLE NUMBERS

Develop subtraction of numbers named by 2-digit numerals with no exchange (regrouping).

Suggestions For Pupil Activities

Use squared material, dimes and pennies. colored rods, multibase arithmetic blocks, and other place value materials to explore ways of computing differences with no exchange.

Review steps in computing differences of the type $\begin{array}{r}37\\ -\underline{\ \ 2}\end{array}$ (See Unit 24 B).

Apply those ideas to substractions of the type $\begin{array}{r}27\\ \underline{-15}\end{array}$

Method I

Show	Relate to: Place Value Form		Standard Form
	2 tens + 7 ones	27	Subtract the ones
	-1 ten - 5 ones	-15	Record the 2
	1 ten + 2 ones	=12	Subtract the tens
			Record the 1

Refer to the materials and compute the difference for each form (Algorithm).

Discuss: How many tens-strips need to be removed?
How many are left?
What is 2 tens minus 1 ten?
How many ones (units) need to be removed?
How many are left?
What is 7 ones minus 5 ones?
What is 1 ten + 2 ones?
What is 27 minus 15?

Method II

Show	Relate to: Expanded Form		Standard Form
	20 + 7	27	Subtract the ones
	-(10 + 5)	-15	Record the 2
	10 + 2	12	Subtract the tens
			Record the 1

Refer to the materials and compute the difference for each form.

Discuss: What is 20 minus 10?
What is 7 minus 5?
What is 10 plus 2?
What is 27 minus 15?

Verify with squared materials that 10 + 2 and 12 name the same number. (See Units 6 and 22).

Use the forms suggested in this unit to compute differences such as:

$$\begin{array}{r} 23 \\ -\ 12 \\ \hline \end{array} \qquad \begin{array}{r} 36 \\ -\ 21 \\ \hline \end{array} \qquad \begin{array}{r} 54 \\ -\ 32 \\ \hline \end{array} \qquad \begin{array}{r} 45 \\ -\ 30 \\ \hline \end{array} \qquad \begin{array}{r} 87 \\ -\ 63 \\ \hline \end{array}$$

Use money to show and practice subtractions.

- Place data concerning a classroom situation on the chalkboard or newsprint.

  Money collected for a get-well card - 35¢
  Cost of the card - 15¢
  Money left -

- Estimate the amount left.

- Record a subtraction algorithm and find the difference.

$$\begin{array}{r} 35¢ \\ -\ 15¢ \\ \hline 20¢ \end{array}$$

Compare the answer with the estimate.

The development of facility with the concepts described in units 24, 27 and 28 is an on-going objective. Provide homework assignments, games, practice exercises and other similar activities which will deepen each pupil's understanding of these subtraction skills.

***

UNIT 29. MEASUREMENT: TEMPERATURE

Reinforce and/or develop concepts of temperature.
Develop skill in taking temperature readings with thermometers.

Suggestions for Pupil Activities

Make comparisons of temperature by engaging in experiences such as:

- Standing in the sun and then in the shade; outdoors and then indoors.
- Working in the classroom before and after the windows are opened.
- Feeling water with ice and without ice.
- Placing one hand in a pan of warm water and another in a pan of cold water.

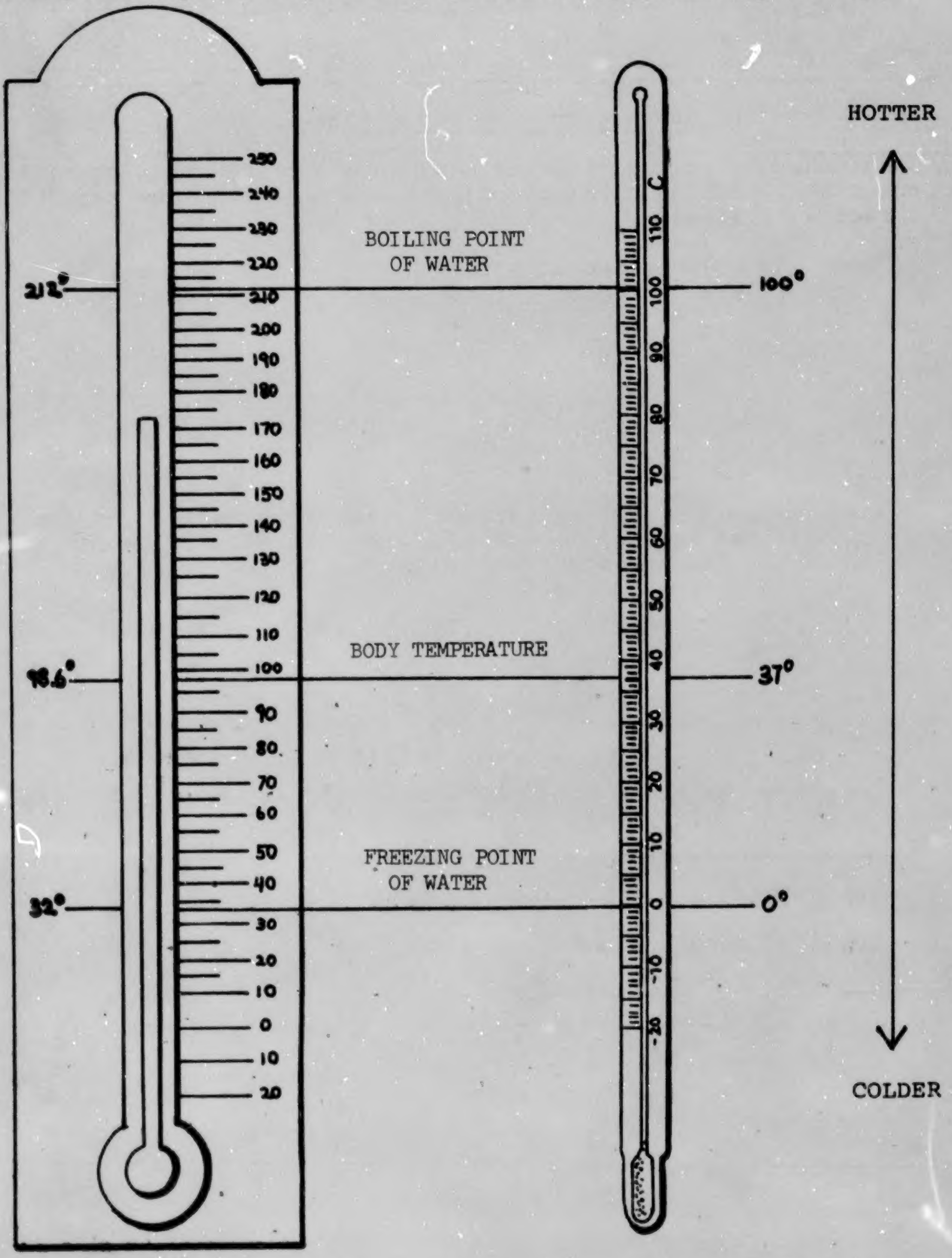
Experiment with thermometers to develop an understanding of how temperature is measured. Use thermometers with either a Fahrenheit or a Celsius scale which will record a range of temperatures from below freezing to above the boiling point of water.

- Place a thermometer in a pan of ice water. Watch the column of liquid. Discuss what happens and record the temperature.
- Place the same thermometer in a pan of warm water. Discuss what happens to the column of liquid and record the temperature.

Compare the temperature readings. Conclude that the column of liquid in a thermometer becomes longer when it gets warmer and shorter when it gets cooler. Discuss the idea that the number symbols help in finding out how high or how low the temperature is.

Note: Temperature should be treated as an on-going topic. Provide opportunities to read the thermometer all year. Be sure that the thermometers to be read by the pupils have large number symbols and spaces clearly marked.

Take outside temperature readings in the morning and in the afternoon. Keep a record or a chart. Compare morning temperature with afternoon temperature. Which is higher? lower? Which is warmer? colder (cooler)?. Does the temperature change during the day? Does the temperature change from day to day?



Fahrenheit Thermometer Celsius Thermometer

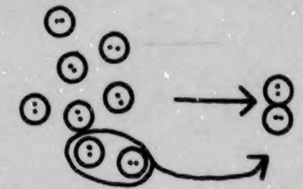
UNIT 30. NUMBER

Reinforce and/or develop counting forward and backward by twos. Develop concepts of odd and even numbers.

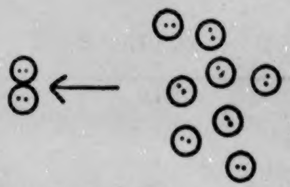
Suggestions for Pupil Activities

Count buttons, discs, egg cartons, interlocking cubes or similar materials. Set up piles of objects and find out "how many" Direct as follows:

- Move the objects two at a time and name the numbers: "two," "four." "six," "eight," "ten."



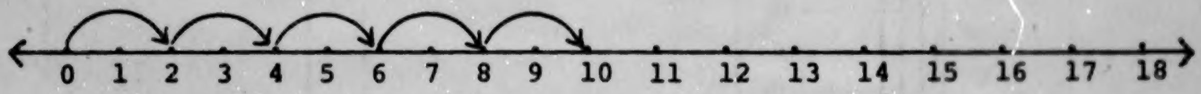
- Count and move the ten buttons backward by twos. Observe that ten buttons have been counted. Move the buttons two at a time and count "eight, six," and so on, to "zero."



- Repeat using other materials and extend to larger numbers.

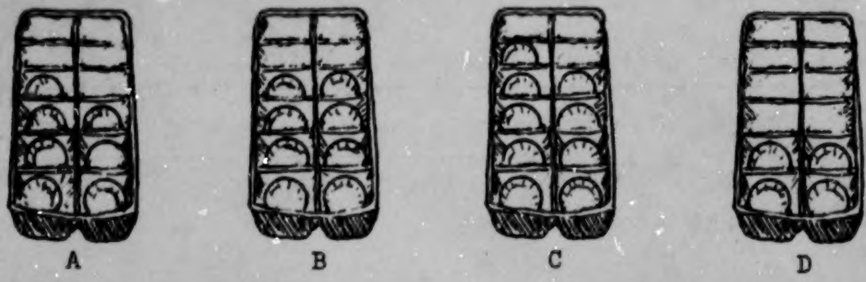
Use number line activities to count.

- Begin at zero. Count forward by twos.



- Record the stops "0, 2, 4, 6, 8, . . ."

Investigate odd and even numbers by placing discs in egg cartons as illustrated below.



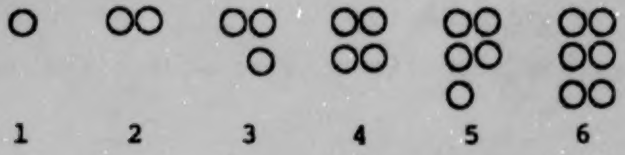
Discus s:

- Is there an odd number or an even number of discs in A? in B? In C? in D?

  If a number of discs is even, what can we do to make an odd number of discs?

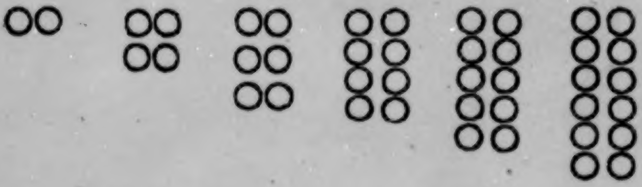
  What can we do to an even number of discs to make an odd number of discs?

- Arrange discs, cubes, bottle tops or other concrete materials as illustrated.



Discuss: Which numbers are odd? Why?
Which numbers are even? Why?

- Arrange the sets of even numbers in a series

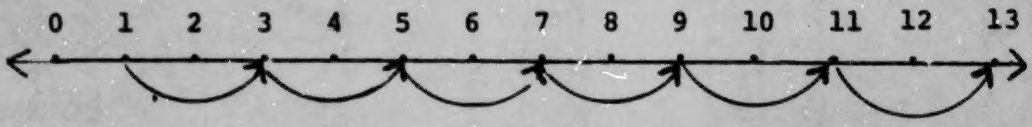


Record the numbers of the sets
2, 4, 6, 8, 10, 12, ...

- Arrange the sets of odd numbers in a series and record the numbers of the sets.

- Investigate other even and odd numbers of objects.

- Begin at one. Count forward by twos.



- Record the stops: "1, 3, 5, 7, ..."

- Repeat the activities and count backward by twos, starting at 18.
  Record the stops 18, 16, 14, ...

  Do the same starting at 13.

Introduce the concept of odd and even by pairing the children.

Discus: Does each child have a partner? If each child has a partner the number of children is called an even number.

If one child has no partner, the number of children is called an odd number.

Use similar classroom situations to reinforce the meaning of odd and even.

**

UNIT 31. MULTIPLICATION OF WHOLE NUMBERS

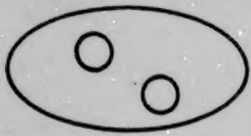
Develop the concept of multiplication as repeated addition.
Develop basic multiplication facts: 2 twos; 3 twos; 4 twos; 5 twos.

Suggestions for Pupil Activities

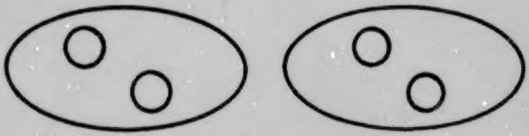
Review and practice counting by twos. (See Unit 30).

Form sets of two by using cookies on a plate, partners for a race, discs, interlocking cubes, beads on a frame or other similar materials. Count the objects by twos and discuss as illustrated:

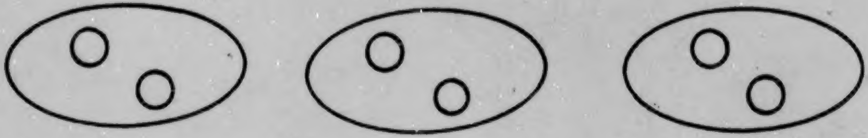
- Put 2 discs on each plate



1 plate has 2 discs or 1 two = 2



2 plates have 4 discs or 2 twos = 4



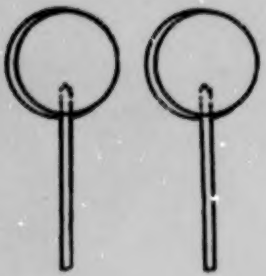
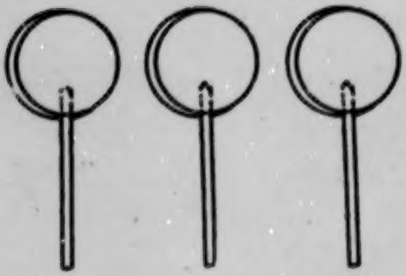
3 plates have 6 discs or 3 twos = 6

- Focus on 3 plates in a row.
  How many plates?
  How many discs on each plate?
  How many discs altogether?

- Summarize
  1 two = 2
  2 twos = 4
  3 twos = 6

- Continue the sequence to derive:
  4 twos = 8 5 twos = 10

Use experience situations to demonstrate successive twos, for example - buying candy.

Candy	Pennies	Discuss
		One candy, 2 pennies
		Two candies, 2 pennies plus 2 pennies 2 + 2 = 4
		Three candies, 2 pennies plus 2 pennies + 2 pennies 2 + 2 + 2 = 6

And so on.

Summarize the activity in chart form.

Candies	Pennies	Number Sentence
1	2	1 two = 2
2	4	2 twos = 4
3	6	3 twos = 6
4	8	4 twos = 8
5	10	5 twos = 10

Teacher's Notes

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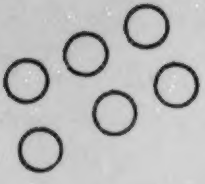
UNIT 32. DIVISION OF WHOLE NUMBERS

Develop the concept of division.
Develop basic division facts - how many two's in 4; how many two's in 6; how many two's in 8, etc.

Suggestions for Pupil Activities

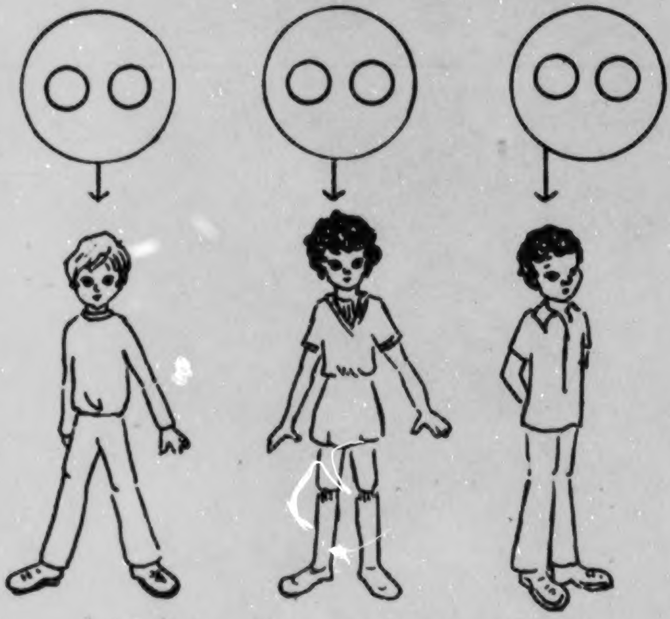
Engage in experiences that involve the action of separating a collection of objects into groups of two.

- **Problem:**



Six cookies. Two cookies to each child.

How many children will receive cookies?



Solution: Three children receive 2 cookies each.

How many two's in 6?

3 two's in 6.

- **Problem:** Ten slices of bread to make sandwiches. How many sandwiches can we make?

- **Solution:** We can make five sandwiches.

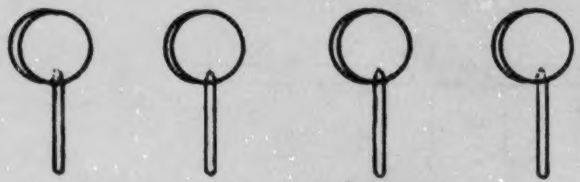
  How many two's in 10? (5)

  There are 5 two's in 10.

- **Problem:** Candy cost 2 cents. How many candies can we buy with 8 pennies?

Pennies:

Candy:



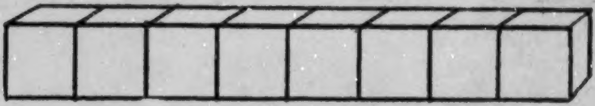
Solution: We can buy 4 candies.

How many two's in 8?

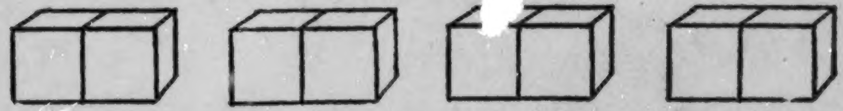
There are 4 two's in 8.

Use small objects such as interlocking cubes, blocks, discs, etc. Explore the division concept by guiding pupils to:

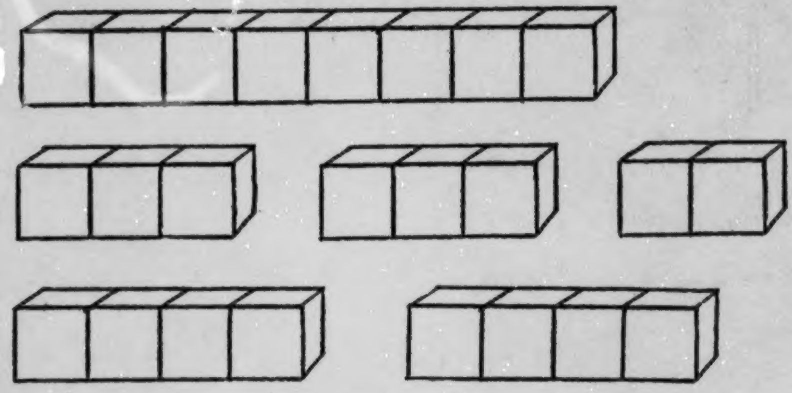
- Select 8 objects



- Separate the 8 objects into groups of 2 objects.



- Separate the same 8 objects into groups of 3; of 4; of 5; etc.
  Each time discuss the number of groups formed.



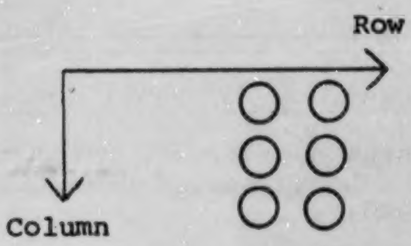
8 in all

2 sets of 3
and 2 extra

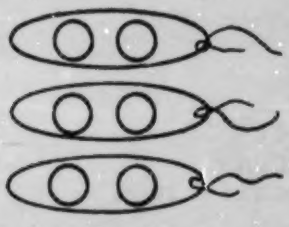
2 sets of 4

Build groups with the same number of objects.

- Arrange six discs or other small objects in three rows with the same number of discs in each row.



- Place a string around sets of two discs.



Discuss:

How many discs in all? (6)

How many groups of two? (3)

How many two's in six? (3)

The response may be recorded as: 3 two's = 6

- In a similar manner, find the number of twos in 4, in 8, in 10 and in 12.

**

UNIT 33. MEASUREMENT: LINEAR

Develop foot-inch relationship.

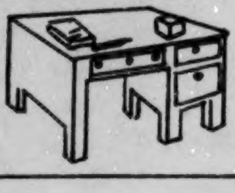
Introduce the metric units centimeter and meter.

Suggestions for Pupil Activities

Engage partners in using nonstandard units to measure the length of the teacher's desk, bookcases, tables, and other similar objects. Record the results.

Linda Taylor and Betty May

We used books, blocks, and pencils to measure the teacher's desk. It is:



4 books long
6 blocks long
10 pencils long

Tony and Alan

The teacher's desk is

6 books long
12 wooden blocks long
7 pencils long

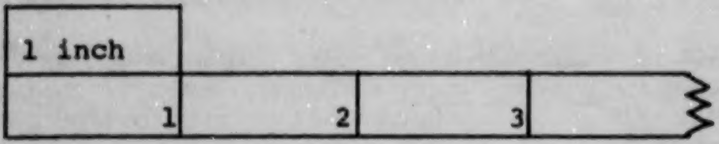
Compare and discuss the findings of each group. Did everybody get the same measurement? What does this tell us about the length of the things with which we measured?

Which of the three measurements on your list is the greatest number? Can you explain why?

Explore the need for standard units of measure. Introduce a foot ruler as a unit of length. Find out "how long" the teacher's desk is in feet.

Make a list of objects in your classroom that are shorter than 1 foot; longer than 1 foot; the same length as 1 foot.

Use an inch unit and a 12 inch strip of oaktag to make an inch-foot ruler.

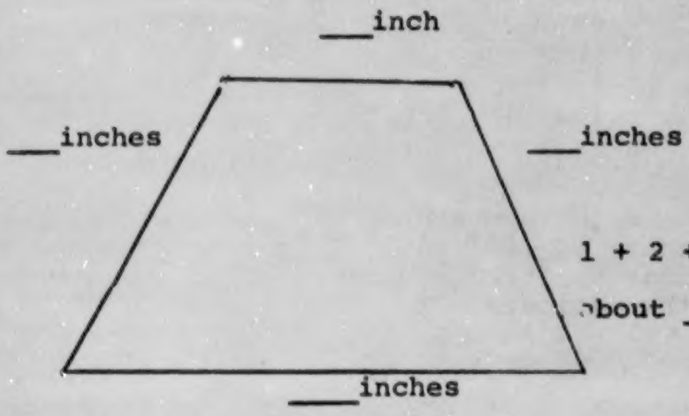


Involve pupils in measuring various objects first with non-standard units such as pieces of string, strips of paper, fingers, hand spans, paper clips, and straws. Then the same objects should be measured with the inch-foot ruler. Records should be kept and discussed.

Object	My Guess	Measurement
Flower Vase	1 foot long	11 inches
Math Book	1 foot long	10 inches
etc.	etc.	etc.

NOTE: Since some of the objects to be measured may not be a given number of whole inches in length, introduce the concept of nearest inch. Use terms such as: about 3 inches; more than 3 inches but less than 4 inches; 3 inches and a little more; between 3 inches and 4 inches; closer to 4 inches than to 3 inches.

Use the inch-foot ruler to measure the line segments constructed in Unit 4. Measure the distance around the geometric shapes formed in Unit 15.



1 + 2 + 3 + 2 =

about ___inches in all

Metric System

NOTE: The metric system of measurement is developed concurrently with the system of measurement in the Scopes and Sequences Grades 1, 2 and 3.

The following activities are designed to guide you and the pupils to Think Metric. Experiences in measuring length are given to introduce students to the common units meter (m) and centimeter (cm).

At this time no attempt should be made to teach prefixes and to make conversions either within the Metric system or in relation to the customary units. However, pupils and teachers could develop a feeling for comparison between units, e.g., a centimeter is less than an inch.

Introduce the metric unit centimeter, by measuring the length of objects using colored rods.

Thing	Length
Crayon	1 blue rod long
Pencil	1 orange and 1 green rod long
Eraser	1 dark green rod long
Width of my finger	1 white rod

Discuss the measurements. Focus on a measurement made with white rods. Indicate that the length of one of the white rods is 1 centimeter long.

Measure the length of the other rods using a white rod as the unit of measure. Record the measurements in centimeters.

Rod	Length
Red	2 centimeters
Green	3 centimeters
Purple	4 centimeters
↓	↓
Orange	10 centimeters

Refer to the objects measured earlier and give their measurement in centimeters, e.g. crayon - 1 blue rod long or 9 centimeters long. Estimate before measuring. Then compare the actual measurement with the estimate.

Measure things with the centimeter ruler. Complete a chart.

	My Guess	Centimeters Long
Nickel		
Dime		
Penny		
Quarter		
Tooth Brush		
Spoon		
Paper Clip		

Introduce the metric unit, meter, by constructing five 20 centimeter rulers, but do not place centimeter markings on the five rulers.

Tape the unmarked rulers end-to-end to produce a meter ruler. Discuss the length as 1 meter long. Relate the meter length to individual heights. Are you taller than 1 meter? shorter than 1 meter? about 1 meter tall?

Use the meter ruler to find the length of things around the classroom.

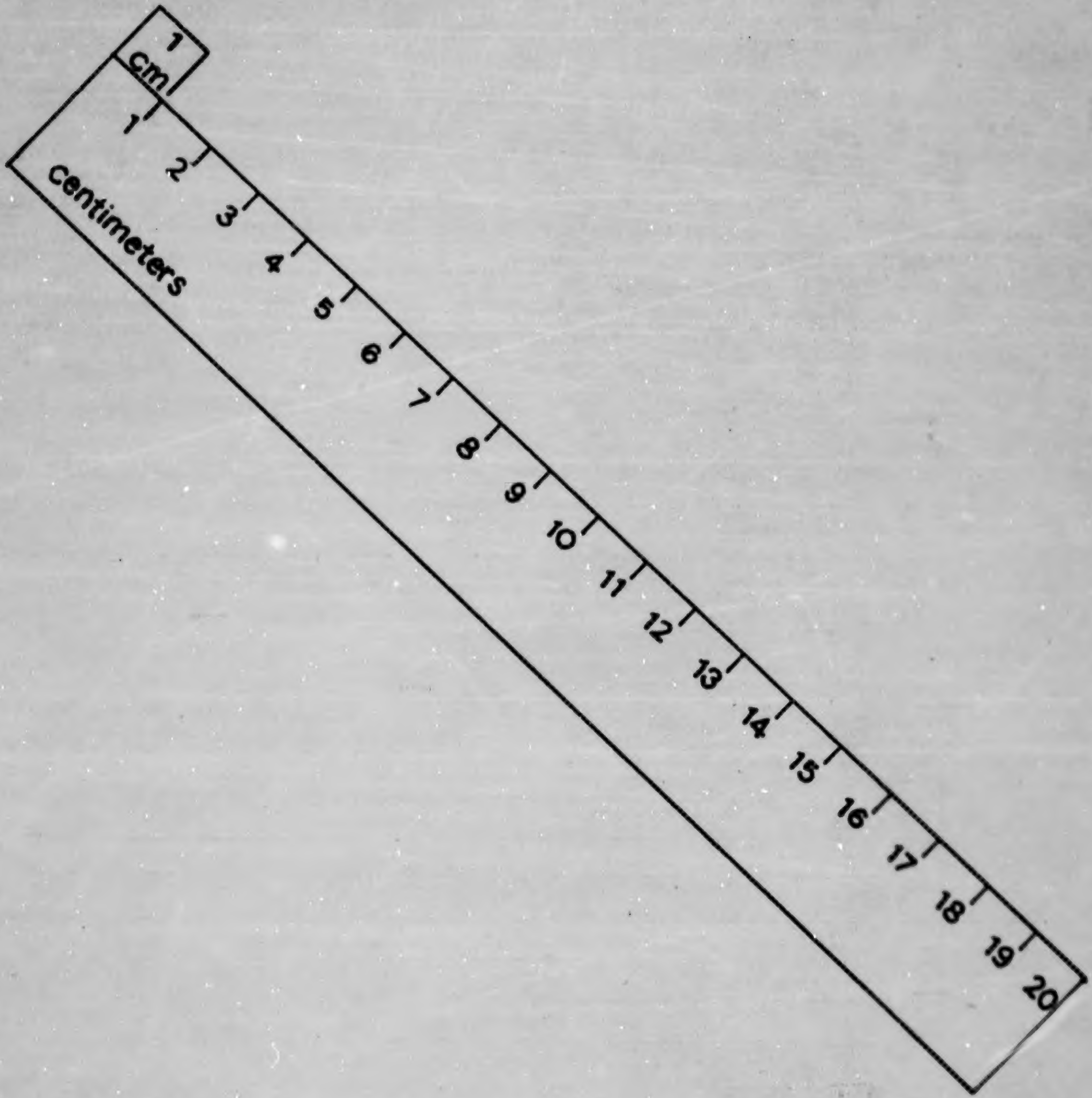
Explore counting on a meter stick with centimeter markings. Find out how many centimeters fit on a meter stick. Hint: colored rods could be used for this investigation.

Measure parts of the body in centimeters. Guess first. Then use the centimeter ruler or tape to find the measurement. Complete a chart.

Parts of my Body	My guess in Centimeters	Measurement in Centimeters
Height		
Waist		
Neck		
Wrist		
Arm length		
Foot length		
Head		
Hand		

Explore your classroom. Make a list of things that are shorter than 1 centimeter; longer than 1 centimeter; same length as 1 centimeter.

Use a white rod and a strip of oaktag the length of 2 orange rods to make a ruler 20 centimeters long.



Use the centimeter ruler to measure the line segments constructed in Unit 4 and the perimeter (distance around) of the geometric shapes formed in Unit 15.

NOTE: Treat all units on linear measurement as a topic for ongoing study throughout the year.

Teacher's Notes

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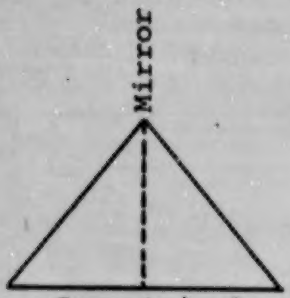
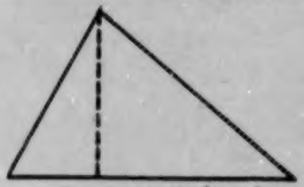
UNIT 34. GEOMETRY: SYMMETRY

Experiment with materials to discover and recognize the difference between symmetrical and asymmetrical patterns, e.g.,



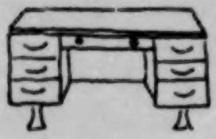
Symmetrical



Asymmetrical

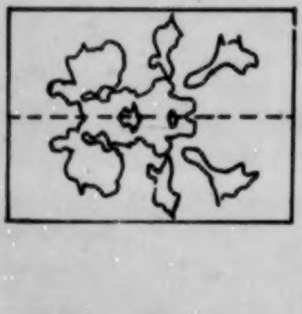
Suggestions for Pupil Activities

Observe symmetry in the environment. Make a collection of objects or pictures that have symmetry. Use mirrors.



Discuss how symmetrical objects or arrangements compare with those which are not symmetrical.

Use paints or inks to make blots. Fold paper along different axes, creating symmetrical patterns.



Make or cut out designs and pictures that show symmetry. Find the place or places on the design where a mirror will complete the picture.
Discuss the lines of symmetry (no lines, 1, 2, or more lines)
Have the children experiment with a mirror.

Help children prepare a set of block letters; numerals. Test for symmetry.

M T CHOICE W
A O H
T M A
T

Use mirror to check.

Using tiles or pattern blocks, form symmetrical regions.

Use geoboards or pegboards to show symmetrical figures.

Draw original mirror cards. Show half a picture or design.
Guess what it is. Use a mirror to check your guess.

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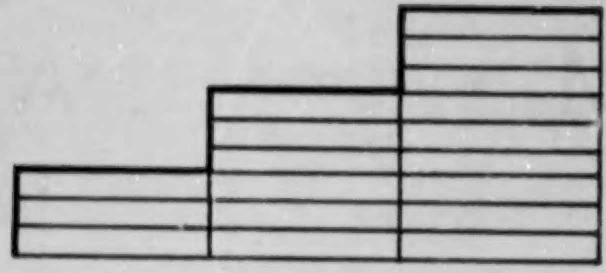
UNIT 35. NUMBER

Develop counting forward and backward by threes.

Suggestions for Pupil Activities

Adapt learning activities in Unit 30 to counting by threes.

Construct a train or a staircase using interlocking cubes, rods, centimeter graph paper, etc. to demonstrate counting by threes.



Circle every third number on a hundred chart.

1	2	③	4	5	⑥	7	8	⑨	10
11	⑫	13	14	⑮	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Record the results: 3, 6, 9, 12, 15, ...

**

UNIT 36. MULTIPLICATION OF WHOLE NUMBERS

Reinforce counting by threes.
Develop basic facts: 2 threes; 3 threes; 4 threes; 5 threes.

Suggestions for Pupil Activities

Use interlocking cubes, squared materials, 1 inch cubes, graph paper and other similar materials to serve as models for facts of three. Through questioning and discussion elicit the following ideas.

red

1 group of three or 1 three = 3

red green

3 + 3

2 groups of three or 2 threes = 6

red green blue

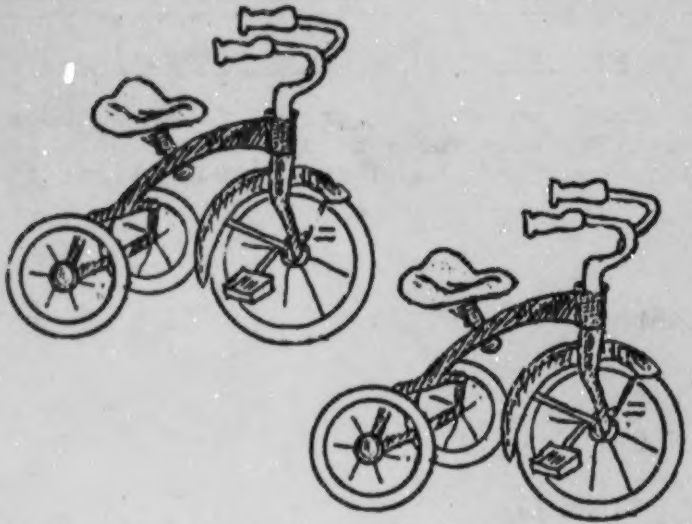
3 + 3 + 3

Three groups of three or 3 threes = 9

continue through 5 threes = 15

Collect and display pictures which show groups of three such as tricycles, tripods, dominoes or spot cards as sets of three. Refer to the pictures and discuss: How many wheels on 1 tricycle? 3 - If there are 3 wheels on 1 tricycle, how many wheels are on 2 tricycles?

If there are 6 wheels on 2 tricycles, how many wheels are there on 3 tricycles?



6 + 3 or 9

Continue in this way to develop facts for three.

Summarize responses in chart form.

Tricycles	1	2	3	4	5	6
Wheels	3	6	9			

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UNIT 37. DIVISION OF WHOLE NUMBERS

Develop basic division facts: threes in 6; threes in 9; threes in 12; threes in 15.

Suggestions for Pupil Activities

Adapt activities in Unit 32. Include experiences such as:

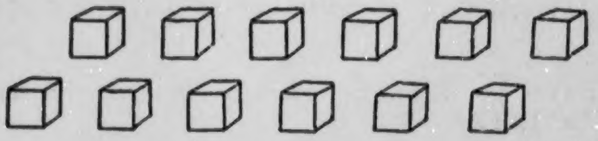
- Buying cupcakes (3 in a package) for 15 children.
- **If there are twelve crayons, how many children can each receive 3 crayons?**

Additional Activities

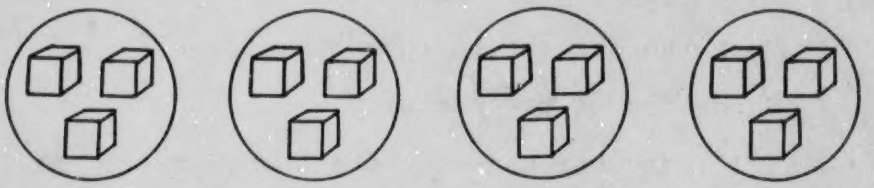
Use interlocking cubes, squared materials, 1 inch cubes, graph paper and other similar materials to serve as models for division.

A. Direct as follows:

- Select 12 cubes



- Form sets of 3



- How many cubes? (12)
  How many sets of three? (4)
  How many threes in 12? (4)

B. Investigate: How many threes in 6; in 9; in 15; in 3. Results may be recorded on a chart.

Cubes	How many sets of 3?
6	2
9	3
15	☐

*

UNIT 38. NUMBER: FRACTIONAL NUMBERS

Develop the concept of thirds of a whole.

Suggestions for Pupil Activities

Investigate the idea of thirds by involving small groups of pupils in:

- separating soil or pebbles to be used for 3 flowerpots.
- sharing a ball or strip of clay among 3 pupils.
- sharing a candy bar.
- pouring paint into 3 containers.
- cutting 3 pieces of string or ribbon of the same length from one piece.

Through discussion and questioning emphasize:

- the methods used to accomplish the tasks.
- that a single object is separated into 3 parts of equal size.
- that each part is 1 third of the whole and the symbol for each part is 1/3.

Use paper models of squares or rectangles to picture thirds. Review the meaning of halves. Then direct as follows:

- Fold the paper shapes into 3 parts of the same size.
- Mark the creases to show 3 parts.
- Shade one of the parts.
- Tell a number name for the shaded part. (1/3 or 1 third).
- Give a number name to each of the other parts.
- Record the symbol 1/3 on each part.

Discuss:

- why each part of the paper shape is 1 third of the whole shape.
- how many thirds there are in 1 whole.
- the sentences 3 thirds = 1 whole

  3/3 = 1

  1/3 + 1/3 + 1/3 = 3/3 or 1

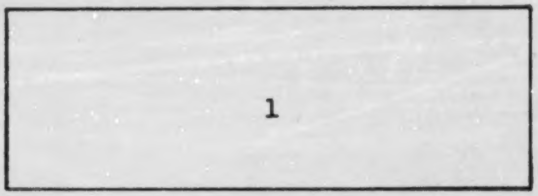
Develop the skill of identifying thirds by encouraging the pupils to collect pictures of objects that are divided into thirds. Initiate class or small group discussions about the pictures. Focus attention on the number of parts and whether the parts are the same size.

Make collages or individual fraction booklets of these pictures.

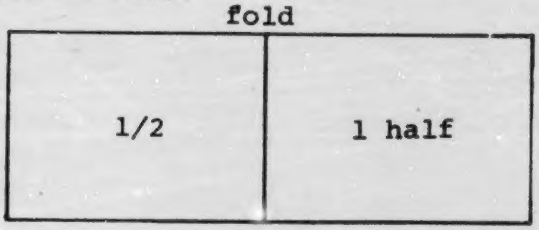
This activity could be extended to include collections of halves and fourths.

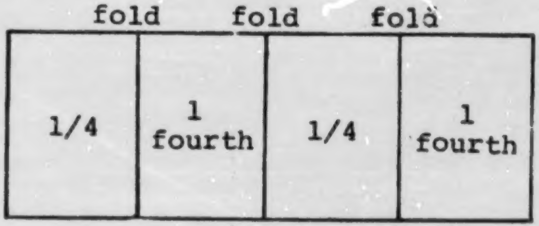
Construct individuals fraction charts to demonstrate relationships among halves, fourths and thirds.

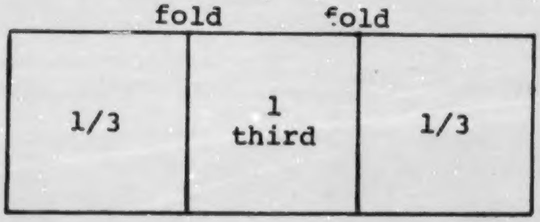
Use 4 rectangular pieces of paper of the same size. Leave the first one whole. Label it 1.



Fold the second rectangle into halves, the third into fourths and the fourth rectangle into thirds. Label each part with its appropriate fraction name.







Staple the form sheets together in this order: 1 (on top), 1/2, 1/4, 1/3. Then cut each sheet on the folds.

Flip the pages of the fraction chart and observe various relationships. Express the relationships in number sentences. Some are listed here.

1/2 is less than 1

$1/2 < 1$

1/2 is greater than 1/4

$1/2 > 1/4$

$1/4 + 1/4 + 1/4 = 3/4$

$3/4 > 1/2$

$1/3 > 1/4$

$1/3 < 1/2$

$2/4 > 1/3$

$2/3 > 1/2$

$1/2 + 1/2 = 1$

$1 - 1/2 = 1/2$

$1/4 + 1/4 = 2/4$

$2/4 = 1/2$

$3/4 < 1$

$3/4 - 1/4 = 2/4$ or $1/2$

$1/4 + 1/2 > 2/3$

$1/4 + 1/4 + 1/2 = 1$

$1/3 + 1/3 + 1/3 = 3/3$ or 1

Use the chart throughout the school year to develop and maintain skill in working with fractional numbers.

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UNIT 39. MEASUREMENT: LINEAR

Reinforce foot-inch relationship and develop the concept of half-inch.
Reinforce the metric units - centimeter and meter.

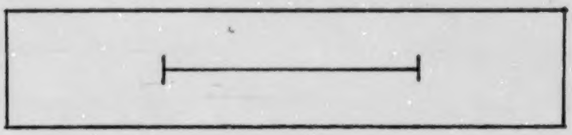
Suggestions for Pupil Activities

Estimate measurements without a ruler. Draw line segments that you think are about 6 inches long; 1 inch long; 4 inches long; 12 inches long; 1 foot long.

Measure with an inch-ruler to check. How close was your guess?

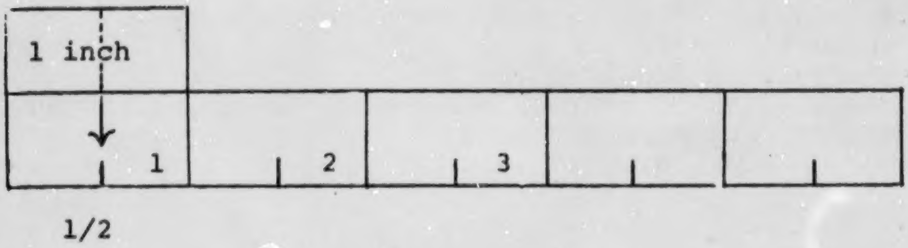
Engage in the same activitiy using the centimeter as the unit of measure.

Investigate half of units of length.
Distribute cards with line segments whose length is more than whole units, such as 1-1/2 inches; 2-1/2 inches.



Direct as follows:

- Estimate (guess) the length in terms of inches.
- Measure the length with the inch-foot ruler made in Unit 35.
- Discuss the measurement in terms of more than 1 inch but less than 2 inches; halfway between 1 and 2 inches.
- Fold a 1-inch unit and place it above the ruler. Mark the half-inch unit on the ruler and introduce the measurement 1/2 inch. Place half-inch markings on the rulers.



- Use the ruler to measure the line segment.
- Record the measurement as 1-1/2 inches. (Read "one and one half inches")

Engage groups of pupils in measuring objects around the classroom and/or parts of the body using the inch-foot rulers. The measurements might be recorded on a chart as shown here.

	My Guess	Measurement
My height		
My friend's height		
Book		
My foot		
Block		
Pencil		
Wagon		

Measure the objects in the above activity with a centimeter ruler.

Use meter sticks or metric tape measures or a metric trundle wheel to measure the length and the width of the classroom. Count the number of whole meters contained in each measurement.

Estimate the part of a meter in excess of whole meters, e.g., the width of the room measures about 10½ meters.

Other distances that can be measured include:

1. The length of the chalk tray
2. The length of the wardrobe closet.
3. The school corridor
4. The various rooms at home
5. The lengths of various designated distances in the schoolyard, such as the boundaries for handball, the baseball diamond, etc.

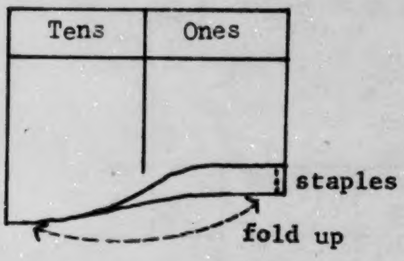
UNIT 40. NUMBER-NUMERATION

Continue to develop and/or reinforce place value concepts involving the whole numbers through 100.

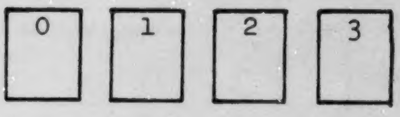
Suggestions for Pupil Activities

Evaluate pupils' understanding of the place value concepts developed in Units 6 and 22.

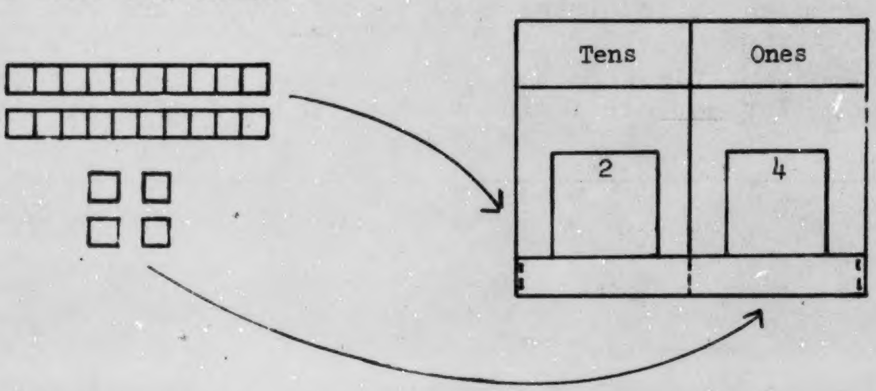
- Make individual place value charts out of oaktag.



- Prepare two cards for each numeral 0-9 to be inserted in the pockets of the place-value chart.



- Represent numbers 0-99 with interlocking cubes, squared materials, abaci, bundles of sticks, colored rods, beads on a frame, or other similar materials.
- Pupils show the number represented by placing the correct cards into the chart.



Group pupils according to the results of an evaluation and adapt the learning activities in Units 6 and 22 to provide further development.

Additional Suggestions

Prepare individual numeral charts to count and order the whole numbers 1-100.

- **Write the numeral in each square of a 10 cm x 10 cm square as shown below.**

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	etc					

- **Look for and discuss number patterns, for example:**

  Read the column beginning with 10. What is the pattern?

- **Read the first (top) row, second row, third row. What is the pattern?**

  Read the first column. What is the pattern? Is there a similar pattern in the second, third and fourth columns?

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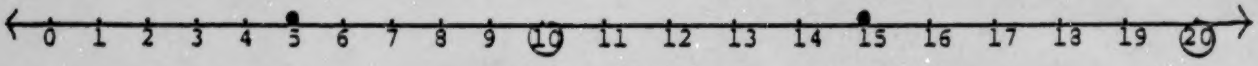
UNIT 41. NUMBER

Develop rounding numbers to the nearest ten.
Use these ideas to estimate sums, differences, and solutions to verbal problems.

Suggestions for Pupil Activities

Involve pupils in preparing number lines or number rays on centimeter dot grids or unmarked strips of number line paper.

- Label points from 0 to 20 in order.
- Darken the point halfway between 1 and 10.
  Do the same for the point halfway between 10 and 20.
- Put a ring around each multiple of 10.



- Locate 16 and discuss:

  Is 16 nearer to 10 or 20?
  What is 16 rounded to the nearest 10?
  Which numbers between 10 and 20 are nearer to 10? nearer to 20?
  Is 15 nearer to 10 or to 20?
  Is it halfway between 10 and 20?
  15 is rounded to 20.
  Conclude that a number halfway between two successive tens is to be rounded to the greater ten.

Estimate sums before computing.

For 11
+18

Discuss: Which of the tens can 11 be rounded to?
Which of the tens can 18 be rounded to?
What is 10 + 20?
The sum of 11 plus 18 is about ________?
Find the exact sum and discuss how close it is to the estimate.

Estimate solutions to verbal problems.

There are 32 red crayons and 56 blue crayons. How many crayons are there altogether?

Through discussion, questioning and the use of a number line, elicit these ideas:

32 rounded to the nearest ten is 30

56 rounded to the nearest ten is 60

30 + 60 = 90

There are about 90 crayons

Compute to find the actual sum. Compare estimate with actual answer.

TEACHER'S NOTES

**

UNIT 42. ADDITION OF WHOLE NUMBERS

Reinforce and continue to develop addition of numbers named by 2-digit numerals without exchange (regrouping).

Extend the development to include addition of more than two addends without exchange. (Column Addition)

Suggestions for Pupil Activities

Adapt the learning activities in Units 24 and 26. Pupils who are having difficulty with those addition skills would benefit from activities with ten-strips and ones (squared material) as well as with pennies and dimes. Work with task cards similar to the ones shown here.

Show 21 with 2 tens and 1 one.
Then show 43 with 4 tens and 3 ones.
How many tens and ones altogether?
Write your answer like this:

$$\begin{array}{r} 21 \\ +\ 43 \\ \hline 64 \end{array}$$

Additional Suggestions

Use place value materials to develop a method for computing sums involving more than two addends.

- Review ways of adding more than 2 addends named by 1-digit numerals without exchange. (See Unit 16).
- Consider examples of the type $\begin{array}{r} 23 \\ 12 \\ +\ 34 \\ \hline \end{array}$
- Represent each addend with squared material and record.

$$\begin{array}{r} 2 \text{ tens} + 3 \text{ ones} \\ 1 \text{ ten} \;\; + 2 \text{ ones} \\ +\ 3 \text{ tens} + 4 \text{ ones} \\ \hline \end{array}$$

To arrive at the sum discuss:

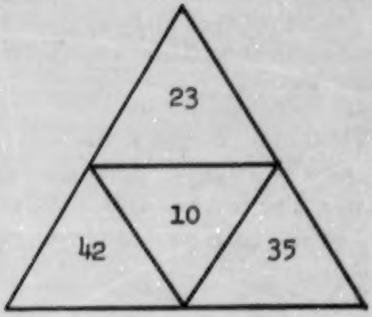
How many tens altogether?
How many ones in all?
How much is 6 tens + 9 ones?

- From the place value chart develop the standard form.

2 tens + 3 ones	23	Add the ones
1 ten + 2 ones	12	Record the 9 Add the tens
+ 3 tens + 4 ones	+ 34	Record the 6
6 tens + 9 ones	69	

Verify with squared materials that 6 tens + 9 ones and 69 name the same number.

Play a target game.



- Toss 2 or 3 bean bags on the court.
- Record scores. Find total score. Compare scores.

My Score

$$\begin{array}{r} 23 \\ +\ 42 \\ \hline 65 \end{array}$$

My Score

$$\begin{array}{r} 35 \\ 42 \\ +\ 10 \\ \hline 87 \end{array}$$

Use money to show and practice addition.

- Place data concerning a classroom activity on the chalkboard or newsprint.

Trip money on hand this morning	43¢
Today we collected	25¢
Now we have	

- Estimate the sum.
- Record an addition algorithm and find the sum.

$$\begin{array}{r} 43¢ \\ +\ 25¢ \\ \hline 68¢ \end{array}$$

- Compare the sum with the estimate.

Make up criss-cross addition examples from a hundreds chart.

- Prepare hundreds chart similar to the one suggested in Unit 40.
- Block out squares of four numbers.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
					etc.	to		100	

- Add the corner numbers.

$$\boxed{\begin{array}{r}12\\+\ 1\\\hline 13\end{array}\quad\begin{array}{r}11\\+\ 2\\\hline 13\end{array}}\qquad\boxed{\begin{array}{r}14\\+25\\\hline 39\end{array}\quad\begin{array}{r}15\\+24\\\hline 39\end{array}}\qquad\boxed{\begin{array}{r}20\\+9\\\hline 29\end{array}\quad\begin{array}{r}10\\+19\\\hline 29\end{array}}$$

- What is interesting about the sums?
- Are the sums the same for any four numbers?

Keep records of classroom and/or school sales, collections, inventory, etc. Discuss ways of finding the total amount.

- Cupcakes Sold At Cake Sale

Vanilla	14
Cherry	21
Strawberry	+ 32

- Inventory of Paint Brushes

Short	10
Medium	5
Long	+ 21

**

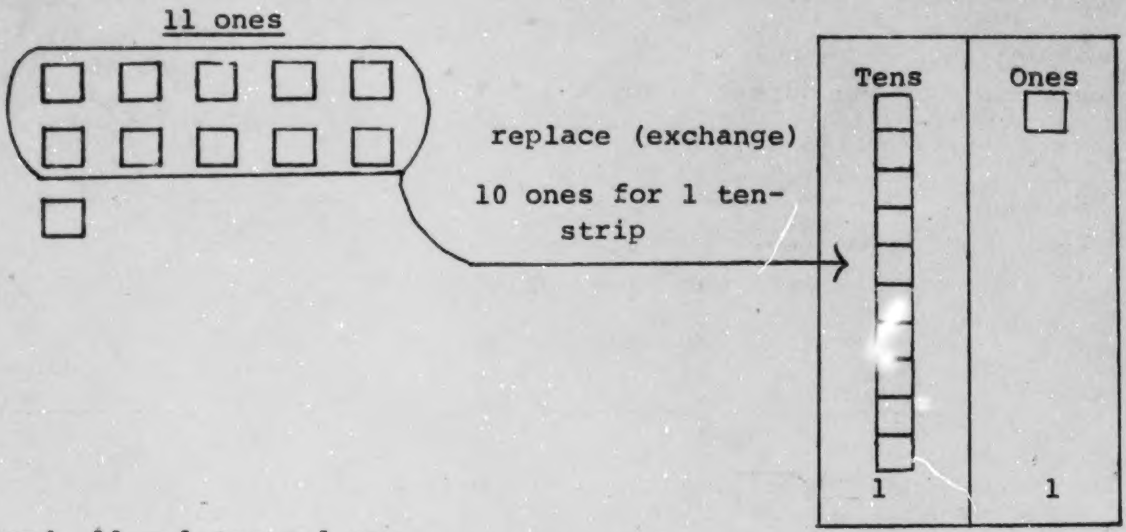
UNIT 43. ADDITION OF WHOLE NUMBERS

Develop addition of numbers named by 2-digit numerals with exchange. (Regrouping ones for tens)

Suggestions for Pupil Activities

Before computing sums with exchange, practice renaming the numbers 11-20 in terms of tens and ones. Use squared materials and place value charts. Record the number represented in various ways.

Show 11 as:

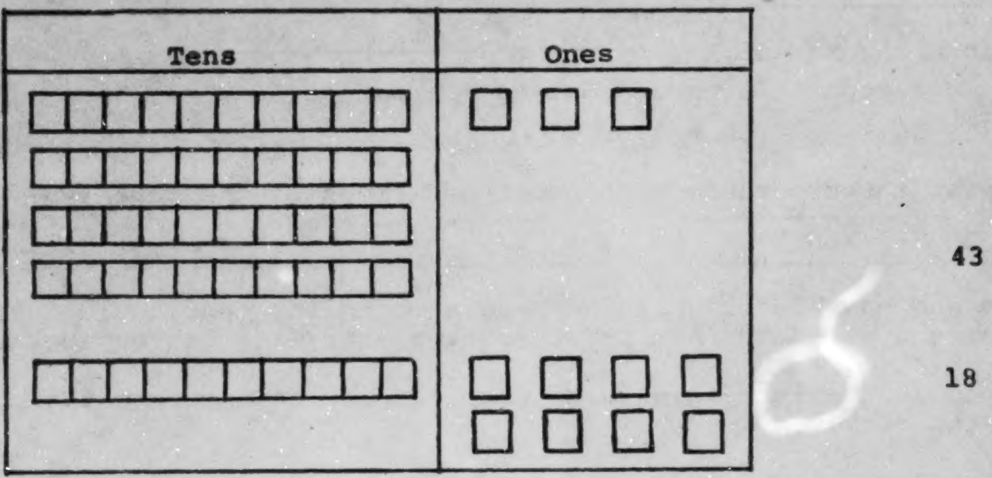


Record 11 = 1 ten + 1 one
11 = 10 + 1

Use place value materials to explore ways of computing sums of the type:

$$\begin{array}{r} 43 \\ +\ 18 \\ \hline \end{array}$$

- Estimate the sum (See Unit 41)
- Represent each addend with squared materials on a place value chart.



- Count in various ways to find sum. (61)
- Refer to the materials and record the addition as:

4 tens + 3 ones
+ 1 ten + 8 ones
5 tens + 11 ones

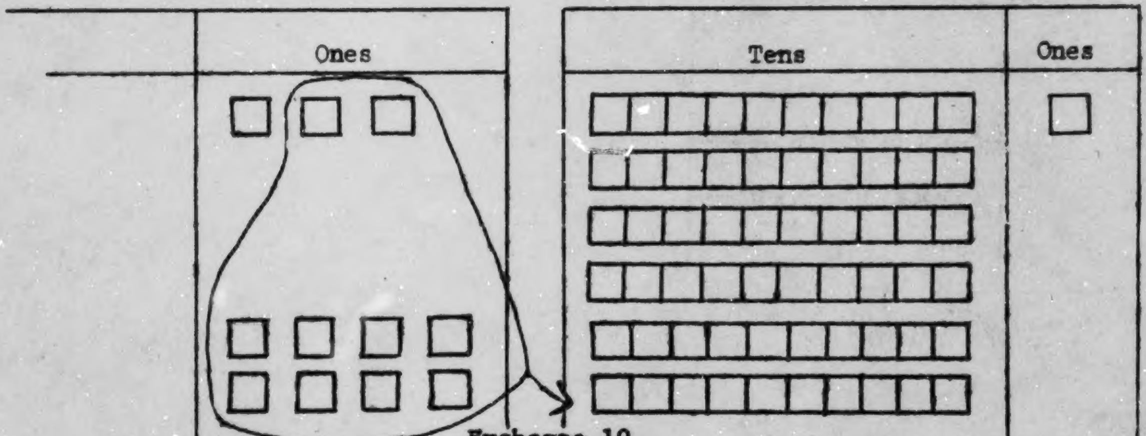
or

40 + 3
+ 10 + 8
50 + 11

Through discussion and questioning conclude:

4 tens plus 1 ten are 5 tens
3 ones plus 8 ones are 11 ones
5 tens + 11 ones is the same as 61

- Refer to the materials and discuss the need for regrouping.



Exchange 10
ones for one
tens strip

- Record the sum as:

  5 tens + 11 ones = 6 tens + 1 one or 61

  50 + 11 = 60 + 1 or 61

- Repeat the procedure with other additions of the same type.

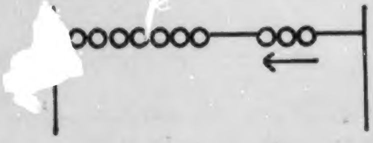
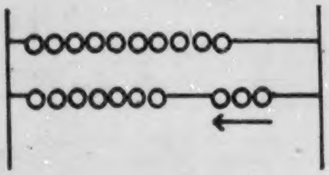
Pupils who have facility in exchanging ones for tens could develop and use the standard form for computing sums with regrouping.

Refer to and manipulate squared materials to demonstrate the following method:

$$\begin{array}{r} 1 \\ 43 \\ +\ 18 \\ \hline 61 \end{array}$$

Add the ones
11 ones = 1 ten + 1 one
Record the 1 in the ones place.
Think or write the 1 in the tens place
Add the tens
Record the 6 in the tens place.

Find sums by exploring patterns. Use individual bead frames, interlocking cubes, squared materials or a series of number lines.

Show	Note
	7 + 3 = 10
	17 + 3 = 20
Continue with 27, 37, 47, 57, 67, 77, 87,	87 + 3 = 90

Examine the pattern and discuss the use of the basic fact 7 + 3 = 10 as an aid in naming greater sums.

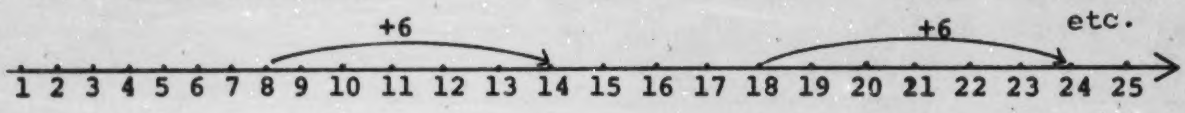
Engage in finding sums through the use of number line activities.

Develop a series such as:

$$\begin{array}{rrrrrrrrr} 8 & 18 & 28 & 38 & 48 & 58 & 68 & 78 & 88 \\ +6 & +6 & +6 & +6 & +6 & +6 & +6 & +6 & +6 \\ \hline \end{array}$$

- On a floor or chalkboard number line with points marked 0-50, circle the starting points 8, 18, 28, 38.

- Demonstrate "plus 6" by a move of 6 spaces to the right of a specified number.



- Summarize the results on a chart.

Starting Number	Move	Stop Number	Addition Sentence
8	6	14	8 + 6 = 14
18	6	24	18 + 6 = 24
28	6	34	28 + 6 = 34
38	6	44	38 + 6 = 44

Discuss the pattern of the addends and the sums. Note the use of the basic fact 8 + 6 = 14.

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Unit 44 Problem Solving

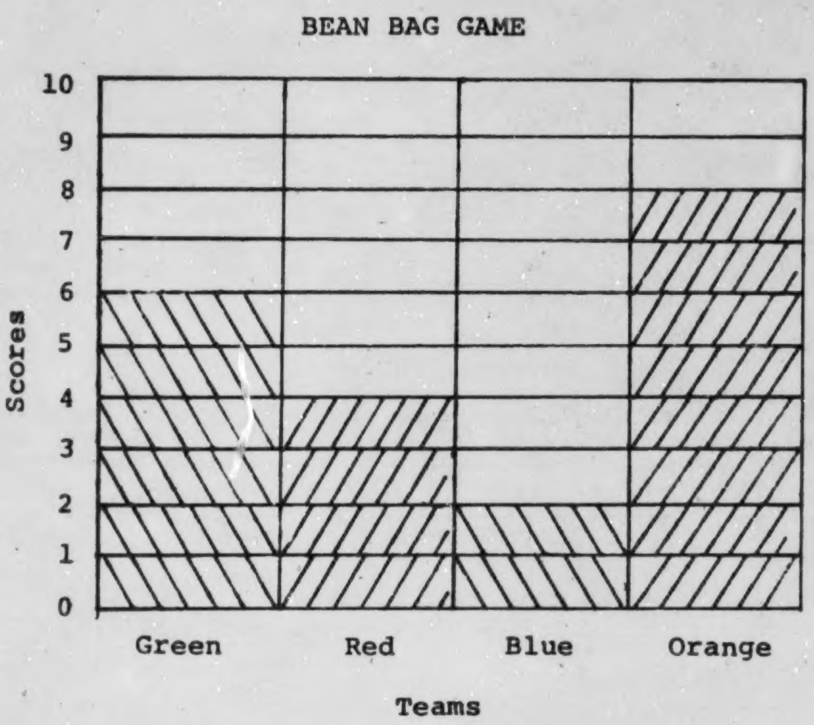
Develop skill in analyzing and solving problems

Suggestions for Pupil Activities

Adapt learning activities for Unit 18

Additional Suggestions

Devise problems based on cooperatively constructed graphs or score charts.



Analyze number information shown on the graph.

Derive number stories, e.g.,

The green team scored 6 points.

The blue team made a score of 2.

Which team made more points? How many more?

Which team made fewer points? How many fewer?

Organize number information in open sentences.

4 + ☐ = 6 or 6 - 4 = ☐

Complete open sentences.

State the solution in a sentence.

The green team made more points than the blue team.

The green team made 2 more points than the red team.

The blue team made fewer points than the green team.

The blue team made 4 points less than the green team.

Use other information from the graph to derive additional verbal problems.

**

UNIT 45. MULTIPLICATION OF WHOLE NUMBERS

Develop basic facts: 2 fours; 3 fours; 4 fours; 5 fours.

Suggestions for Pupil Activities

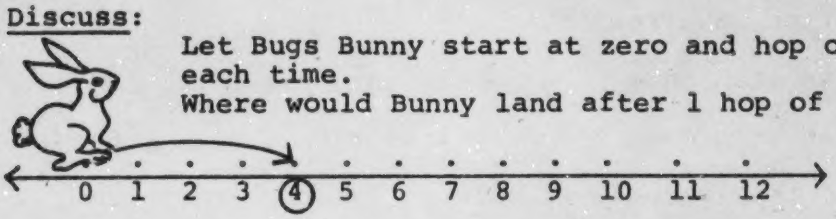
Provide opportunities for children to count by fours.
Adapt activities in Unit 35 to counting by fours.
Then adapt activities in Units 31 and 36 to develop basic facts involving sets of four.

Additional Suggestions

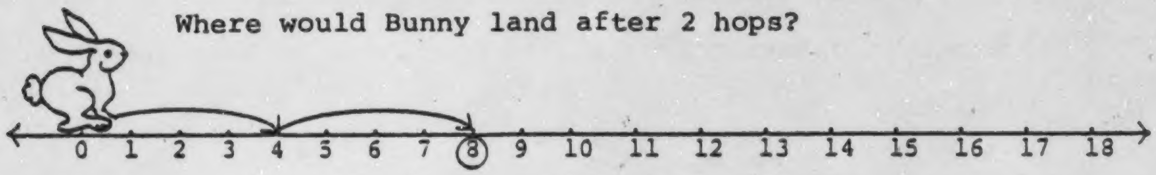
Involve pupils in deriving multiplication facts using number line activities. Use chalkboard, prepared or walk-on number lines and magnetic discs, toy crickets, toy rabbits, pupils, etc.

Discuss:

Let Bugs Bunny start at zero and hop over 4 spaces each time.
Where would Bunny land after 1 hop of four?



Where would Bunny land after 2 hops?



Where would Bunny land after 3 hops? 4 hops, and so on.

Keep a record of Bunny's hops.

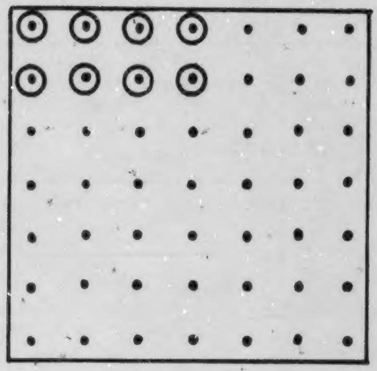
Hops	Landing Places
1	4
2	8
3	12

etc.

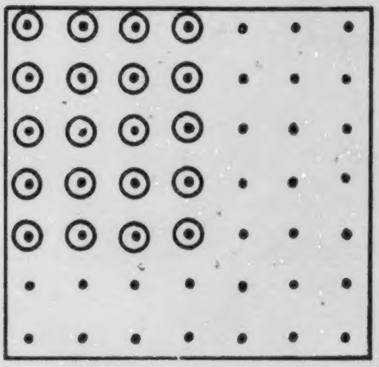
Use pegboard or geoboard activities to generate the basic facts for fours.

Give directions such as:

- Put 4 pegs in a row.
- Build another row of 4 pegs directly below the first row.



- Continue to build rows of 4 pegs through 5 rows.



- Describe the activity using addition and multiplication sentences.

1 row of 4 pegs = 4 or 1 four = 4

2 row of 4 pegs = 4 + 4 = 8 or 2 fours = 8

3 rows of 4 pegs = 8 + 4 = 12 or 3 fours = 12

etc.

**

UNIT 46. DIVISION OF WHOLE NUMBERS

Develop basic facts: fours in 8; fours in 16; fours in 20.

Suggestions for Pupil Activities

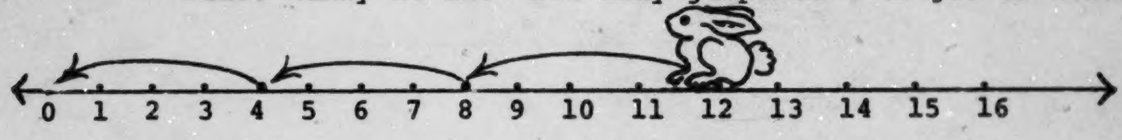
Adapt activities in Units 32 and 37 to develop division involving sets of four.

Additional Suggestions

Involve pupils in demonstrating division using number line activities. Use chalkboard, prepared or walk-on number lines and magnediscs, toy crickets, toy rabbits, children, etc.

- Discuss:

Place Bunny at 12. How many jumps of 4 to get to zero?



Bunny made 3 jumps of 4 to get to zero.
How many fours in 12?
3 fours in 12.

- Let Bunny make other jumps of 4. Keep a record.

Starting Number	Hops to Zero
8	2
16	4
20	-
4	-

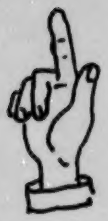
*

UNIT 47. NUMBER-NUMERATION: ROMAN NUMERALS

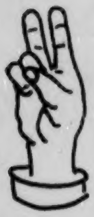
Develop symbols for expressing Roman numerals

Suggestions for Pupil Activities

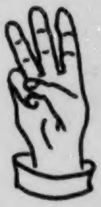
Use hands and fingers to show Roman numerals



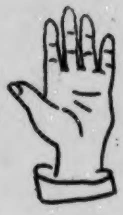
I



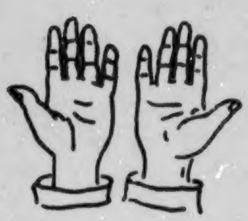
II



III



V



X

Discuss the symbols the Romans used for one, five, and ten.

Investigate combinations of I, V, X to show Roman symbols for two, three, four, six, seven, eight, nine, eleven and twelve.

Put Roman numerals on clock face and practice reading time.

**

UNIT 48. MEASUREMENT: MONEY

Develop the relationships of 1 dollar to pennies, dimes, nickels, quarters and half-dollars.

Suggestions for Pupil Activities

Evaluate the pupils' skill in working with coins by involving them in experiences such as: buying and selling in a classroom store, collecting money for milk, lunch, a contribution, making purchases for a class party, completing personal "sales slips."

Name		Date
Had	Spent	Change
20¢	18¢	2¢

Involve the pupils in making up problems about buying things with the coins used in Unit 7 and discuss recording 1 dollar in the dollars and cents form.

100¢ = $ 1.00

symbol for dollars

the point separates the numeral for the dollars from the numerals for the dimes and pennies.

Collect ads or wrappings of food items that cost 1 dollar or less. Make charts with this information to show "What You Can Buy For A Dollar."

Explore different combinations of coins equivalent to $1.00. Record results in chart form.

Pennies	Nickels	Dimes	Quarters	Half Dollars	Amount
	10	5			$1.00
25	5		2		$1.00
	1	2	3		$1.00

A procedure follows:

discuss the problem
"act out" the problem with coins
express the action in a mathematical sentence
solve the problem

Additional Suggestions

Adapt the procedure in Unit 7 to identify coins that are equivalent in value to 1 dollar. Record the result in chart form.

Coins	Value
100 pennies	100¢
10 dimes	100¢
20 nickels	100¢
4 quarters	100¢
2 half dollars	100¢
1 dollar	100¢

→ 1 dollar

100 cents
100¢

**

UNIT 49. SUBTRACTION OF WHOLE NUMBERS

Develop subtraction of numbers named by 2-digit numerals, with exchange. (Regrouping tens for ones).

Suggestions for Pupil Activities

Before computing differences with exchange practice renaming the whole numbers through 99 in terms of tens and ones. Use squared materials and place value charts. Record the number represented in various ways.

- Represent 43 as:

Replace (exchange)
1 ten for 10 ones to
show more ones

43 = 4 tens + 3 ones	43 = 3 tens + 13 ones
43 = 40 + 3	43 = 30 + 13

- Verify by counting that 4 tens + 3 ones and 3 tens + 13 ones both name the same number. i.e. 43.

Use place value materials or dimes and pennies to explore ways of computing differences of the type:

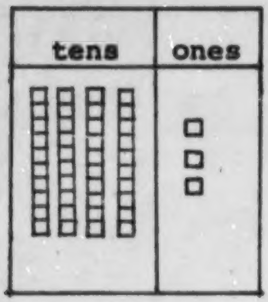
$$\begin{array}{r} 43 \\ -\ 26 \\ \hline \end{array}$$

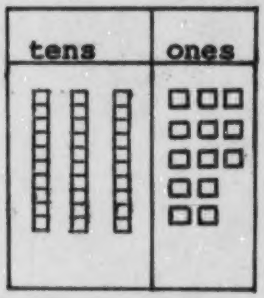
- Estimate the difference (See Unit 45)
- Represent 43 with squared material on a place value chart.

- **Discuss the number to be subtracted in terms of:**

  How many tens need to be taken away (subtracted)?
  How many ones need to be subtracted?
  Are there enough ones?
  How can 43 be shown with more ones?

- **Exchange 1 tens-strip for 10 ones and represent 43 as:**





3 tens + 13 ones

Count to verify that the number requested is still 43.

- Manipulate the materials and discuss:

  How many ones need to be subtracted? (6)
  How many ones are left? (7)
  How many tens need to be subtracted? (2)
  How many tens are left? (1)
  What is 43 minus 26? (17)

- Record the results of the manipulations in the form of algorithms such as:

4 tens + 3 ones	Exchange 1 tens-strip	3 tens + 13 ones
-(2 tens + 6 ones)	for 10 ones	- 2 tens - 6 ones
		1 ten + 7 ones

- Repeat the procedure with other subtractions that require exchanging.

  1 ten for 10 ones.

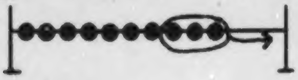
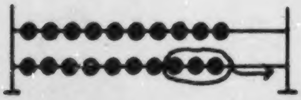
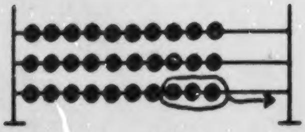
Pupils who have facility in exchanging tens for ones could develop and use the standard form for computing differences with regrouping.

Refer to and manipulate place value materials to demonstrate the following method:

$$\begin{array}{r} \overset{3}{\cancel{4}}\;\overset{13}{\cancel{3}} \\ -\,2\;\;6 \\ \hline 1\;\;7 \end{array}$$

- Determine that there are not enough ones to subtract 6 ones.
- Rename 43 as 3 tens + 13 ones.
- Subtract the ones
- Record the 7
- Subtract the tens
- Record the 1

Find differences by exploring patterns. Use individual bead frames, interlocking cubes, squared materials or a series of number lines.

Show	Move Back	Record
. 	3	10 - 3 - 7
. 	3	20 - 3 = 17
. 	3	30 - 3 = 27
. Continue with 40, 50, 60, 70, 80, 90		90 - 3 = 87

- Observe and discuss a pattern in the answers (differences).
- (Optional) Use the pattern to complete 100 - 3 = ☐

110 - 3 = ☐ 120 - 3 = ☐ etc.

Engage in finding differences through the use of number line activities.

Develop a pattern such as:

11	21	31	41	51	61	71	81	91
- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3

- Prepare a number line similar to the one described in Unit 41. Circle the starting points 11, 21, 31, 41.
- Demonstrate "minus 3" by a move of 3 spaces to the left of a specified number.
- Summarize the results on a chart.

Starting Number	move ←	Stop Number	Subtraction Sentence
11	3	8	11 - 3 = 8
21	3	18	21 - 3 = 18
31	3	28	31 - 3 = 28
41	3	38	41 - 3 - 38

- Observe and discuss the pattern of the 3 numbers in the subtraction sentences.
- Use the pattern to find the differences of:

  51 - 3; 61 - 3; 71 - 3; 81 - 3; 91 - 3.

**

Unit 50. Measurement: Capacity

Reinforce and/or develop cup-pint-quart-relationship.

Introduce Metric units of capacity: liter

Suggestions for Pupil Activities

Experiment with nonstandard units of liquid measure by filling an aquarium with water. Use a plastic glass one time, then a bowl and lastly, a pitcher.

Record the number of full glasses needed; the number of full bowls and the number of pitchers. Compare numbers. Discuss the different counts and the need for standard units of liquid measure.

Introduce the standard units: cup, pint, quart. Use these standard units to fill the aquarium. How many cups full of water fill the aquarium; how many pints? how many quarts? Is the amount of water the same?

Experiment with water or fine sand to determine the relationship between cup and pint; pint and quart; cup and quart. Fill standard containers and keep records in various ways. Estimate first.

- Charts

Cups		Pints		Quarts	
2		1			
4		2		1	

etc.

Discuss:

Which holds more 1 cup or 1 pint?
Which holds less 1 quart or 1 pint?
How many cups fill a pint container?
a quart container?
How many pints fill a quart container?

Experiment with different shaped containers of the same capacity to note that although the shape of the container may vary, the amount of liquid it contains is the same.

Do all these different quart containers hold the same amount of water?

Find 2 or more different containers that hold 1 pint; 1 quart; 1 cup.

Collect pictures of things that are commonly measured in terms of cup, pint, and quart. Prepare charts which might be extended as more items are suggested.

TEACHER'S NOTES

METRIC SYSTEM

Note: Introduce the metric unit liter in a very informal manner. At this time no attempt should be made to teach prefixes and to make conversions either within the metric system or in relation to the customary units. However, pupils and teachers could develop a feeling for comparison between units, e.g. a liter is more than 1 quart.

Work with a liter measure. Find some containers in the classroom and guess whether they hold 1 liter, more than 1 liter or less than 1 liter. Check the estimate by pouring water or fine sand from the containers into a liter measure. Record the results on a chart.

About 1 liter	More than 1 liter	Less than 1 liter

Note: Treat capacity as a topic for ongoing study throughout the year.

**

Unit 51. Multiplication of Whole Numbers

Develop basic facts: 2 fives; 3 fives; 4 fives; 5 fives.

Introduce the multiplication symbol X.

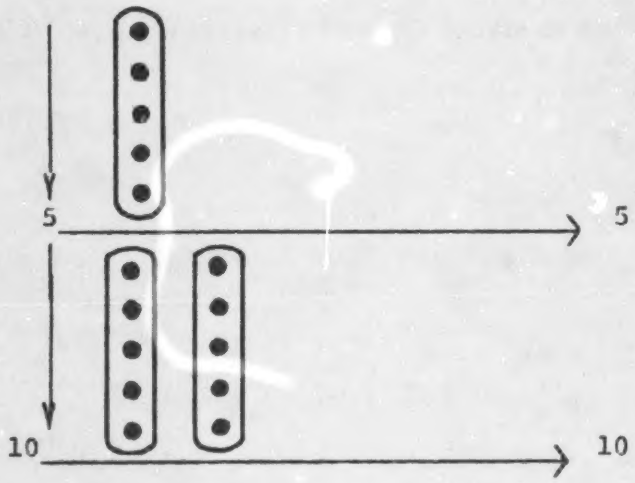
Suggestions for Pupil Activities

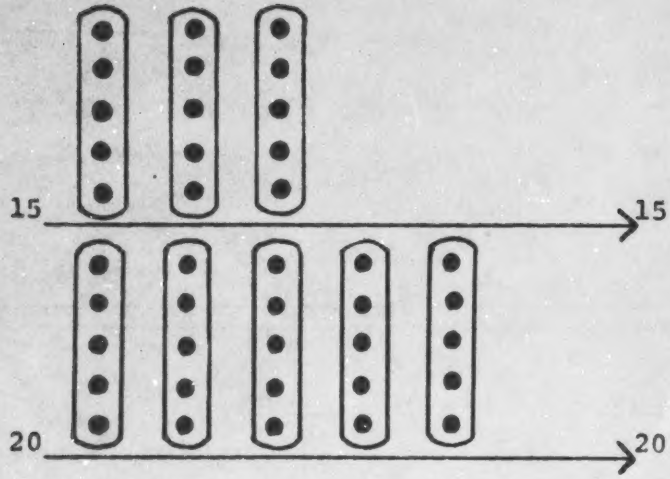
Provide opportunities for children to count by fives. Adapt activities in Unit 39 to counting by fives.

Then adapt activities in Units 31, 36 and 45 to develop basic facts involving sets of five.

Additional Suggestions

Use previously prepared bean sticks or spot strips showing sets of sets of five. Arrange sticks in rows and columns.





and so on.

Refer to the arrangement of sticks and explore patterns by:

- Counting beans horizontally and vertically by fives.
- Completing sentences about the arrangement

  1 five = 5

  2 fives = 10

  3 fives = 10 + ☐

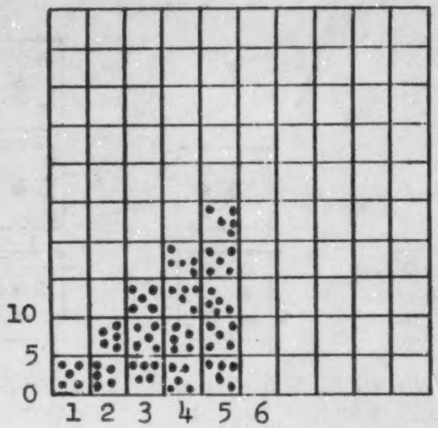
- Writing addition and multiplication sentences to describe the rows of sticks, e.g.

  4 fives = 20

  5+5+5+5 = 20

  4 x 5 = 20 (Read as: four fives equals twenty; four times five equals twenty)

Note: Sentences with the multiplication symbol "X" could be introduced at this time.



Read the number information on the graph to complete the open sentences such as:

5 fives = _________

2 fives =

3 fives = _________

1 five =

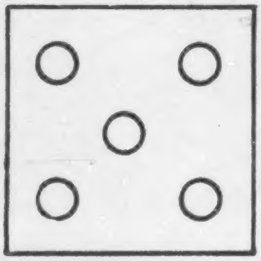
Sentences with the multiplication symbol (X) could be introduced.

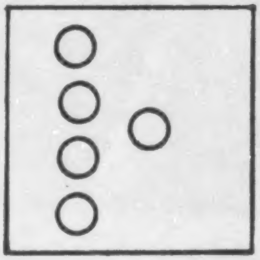
1 x 5 = 5 (read as one five or one times five)

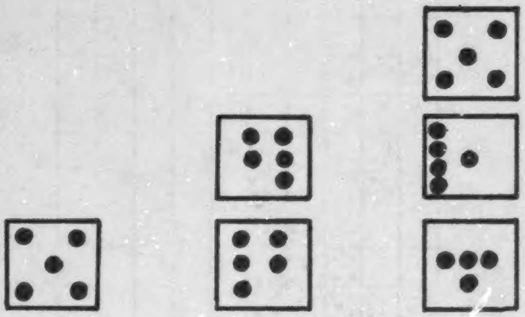
2 x 5 =

and so on.

Use previously prepared spot cards or cards with buttons to construct graphs for facts of fives.







Place spot or button cards in a sequence as shown to picture multiplication facts with five as a factor. Through discussion and questioning elicit ideas such as:

- If 1 card has 5 spots how many spots do 2 cards have?

  3 cards? 4 cards? etc.

- Start at zero point, count by fives and name the points.

**

UNIT 52. DIVISION OF WHOLE NUMBERS

Develop basic division facts: fives in 10; fives in 15; fives in 25.

Suggestions for Pupil Activities

Adapt activities in Units 32, 37 and 46 to develop division involving sets of five.

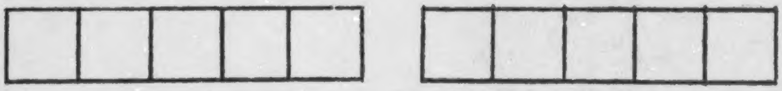
Additional Suggestions

Demonstrate division using squared materials or centimeter graph paper.

Direct as follows:

- Cut a length of 10 units.

- Cut again to show fives in ten.



2 fives

- How many fives are there in 10?

2 fives in 10

- Repeat the activity with lengths of 15 units, 20 units, and 25 units.

Explore separating a collection of cubes into various subsets.

- Take a handful of cubes. Count them.
- Form sets of twos. How many twos? How many extra?
- Arrange the same cubes into sets of threes, fours, of fives, etc.
  Record the results on individual sheets.

For Example.

NAME **Jose**

Number of Cubes in handful 9

Size of Sets	Number of Sets	Extra
twos	4	1
threes	3	0
fours	2	1
fives	1	4
sixes	-	-

**

UNIT 53. OPERATIONS: FRACTIONAL NUMBERS

Develop the concept of fractional parts of a number of things.

Develop skill in identifying 1/2 and 1/4 of a number of things.

Suggestions for Pupil Activities

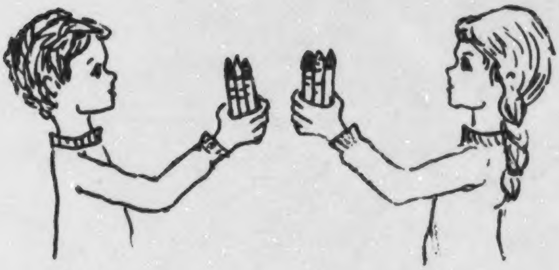
Review 1/2 of a single object. (See Unit 19).

Explore ways of dividing collections of things in half. For example:

6 crayons shared equally by 2 children

Before sharing

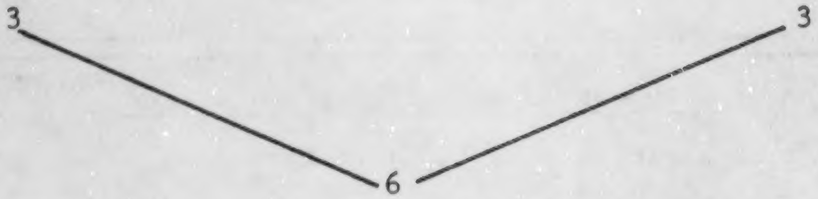
After sharing



Through discussion emphasize the following ideas:

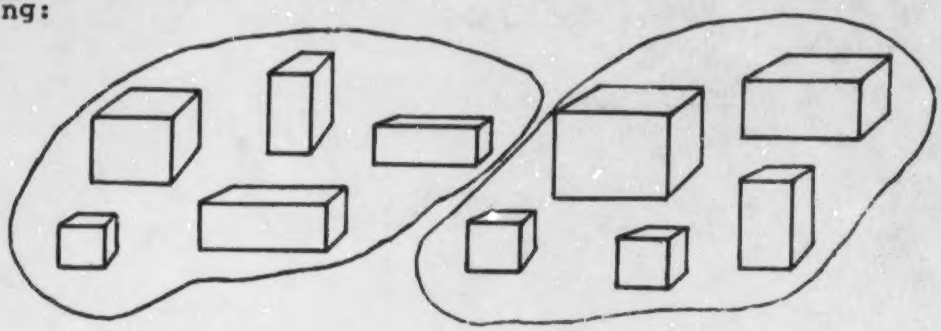
- 6 crayons to share
- 3 crayons for each child
- 3 is one-half of 6
- 1 half of 6 is 3
- the number of crayons in one half is the same as the number of objects in the other half
- both halves put together contain all the crayons

1 half of 6 crayons and 1 half of 6 crayons



Similar action opportunities for pairs of pupils could be presented using:

10 Blocks



5 is 1 half of 10 1 half of 10 is 5

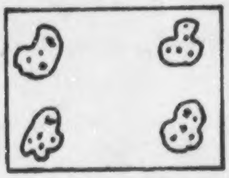
8 Marbles

4 is 1 half of 8 1 half of 8 is 4

4 Cookies

Before Sharing

After Sharing



1 half of 4 is 2 2 is 1 half of 4

Involve pupils in finding 1 half of a number of objects by presenting non-sharing experiences such as:

put 1 half of these books on the shelf
put 1 half of these plants on the table
put 1 half of the candies in a dish
put 1 half of the pennies in a bank

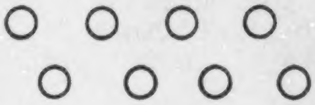
Dramatize and summarize each experience by discussing the number of objects altogether; the number of objects that are in each half; each half has the same number of objects.

Develop the ability to identify 1 fourth of a number of things by manipulating discs, beads, blocks, beans, bottle caps or other small objects.

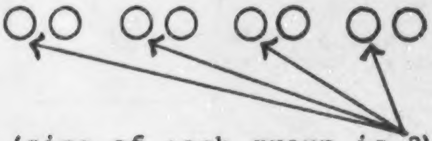
Investigate ways of separating a group of 8 discs into 4 equal parts.

Through discussion emphasize:

- original size (number) of groups



- divided into 4 groups (parts) with the same number of discs in each



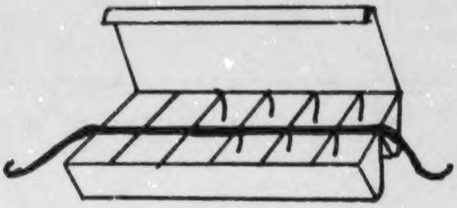
- number (size of each group is 2)
- each part is 1 fourth of the original group
- 1 fourth of 8 is 2
- 2 is 1 fourth of 8

These understandings may be extended to include the number of discs in 2 fourths, 3 fourths, 4 fourths, and 1 half of the discs.

Use empty egg cartons and colored string to show 1 half of 12 and 1 fourth of 12.

Demonstrate answers to questions such as:

How many sections in the egg carton? (12)
Divide the carton into halves.
How many sections in 1 half of the egg carton? (6)



What is 1/2 of 12?

How many sections in the egg carton? (12)
Divide the carton into fourths.
How many sections are there in 1 fourth of the egg carton? (3); in 2 fourths of carton? in 3 fourths; in 4 fourths.

What is 1/4 of 12?
If 1/4 of 12 is 3, what is 2/4 of 12?
What is 3/4 of 12; 4/4 of 12?

***

UNIT 54. MEASUREMENT: QUANTITY

Develop the concepts of dozen and half-dozen

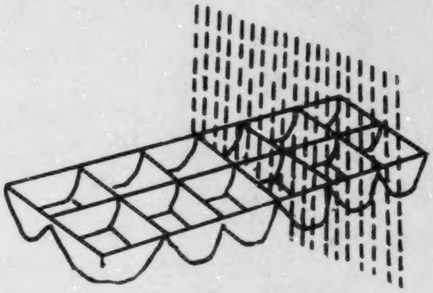
Suggestions for Pupil Activities

Use containers with twelve compartments such as egg cartons or muffin tins.

Investigate how many objects such containers hold by placing one object in each cell of the carton. Count the objects. Introduce 1 dozen as another name for a set of twelve things.

Make a list and/or a bulletin board display of things that are sold by the dozen.

Work with empty egg cartons. Determine that there are twelve or 1 dozen empty cells. Using a lace or string to demonstrate different ways of separating the carton into two sets with the same number of empty cells (equivalent sets).



Discuss:

How many compartments in the carton?

What is another name for twelve?

How many compartments in each half carton?

How many things are there in 1-half dozen?

**

UNIT 55. MULTIPLICATION OF WHOLE NUMBERS

Develop the understanding of the commutative property of multiplication.

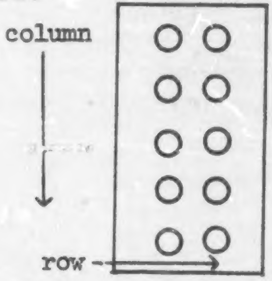
Suggestions for Pupil Activities

Explore the commutative property of multiplication through the use of arrays. (An array is an orderly arrangement of objects or symbols in columns and rows).

Provide discs, 1-inch blocks, unit squares and a rectangular piece of paper.

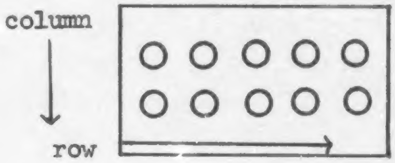
Direct as follows:

- Pick 10 discs
- Form 5 rows with 2 discs in each row
- Write a multiplication sentence that describes the picture.



5 twos = 10 or 5 X 2 = 10

- Turn the paper on its side to show 2 rows with 5 discs in each row. Write a multiplication sentence



2 fives = 10 or 2 X 5 = 10

- Ask: Has the total number of discs changed?
- Refer to the pairs of multiplication sentences.

5 twos = 10　　　2 x 5 = 10
or
2 fives = 10　　　5 x 2 = 10

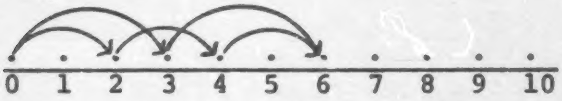
- Discuss similarities and differences.
- Form arrays for other products to demonstrate that changing the order of the factors does not change the product.

Some other materials suitable for this activity are:

Six pack holders, egg cartons or muffin tins.

Use number line activities to demonstrate the commutative property of multiplication.

- Start at zero. Make 3 hops of two. Where do you land? Write a multiplication sentence.



- Start at zero. Show 2 hops of three. Where do they land? Write a multiplication sentence.
- Discuss the idea that the products are the same.

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UNIT 56. MEASUREMENT: WEIGHT

Reinforce concept of standard unit of weight: pound, and develop concept of ounce.

- Introduce metric units of weight: gram, kilogram (mass)

Suggestions for Pupil Activities

Make comparisons of weight by using balance scales and small objects.

Direct as follows:

- Find 2 small objects. Hold them in your hands. Which do you think is heavier (or lighter)?
- Put them on the scale. Were you right?
- "Weigh" some other things.
- Find 2 things that balance each other. (Weight the same).
- Find other things that weigh the same.

NOTE TO TEACHER:

Weight - Mass

There is a difference between the weight of an object and its mass; for example, an object weighs more on the earth than it does on the moon because the gravitational "pull" is stronger on the earth than it is on the moon. The weight of an object is the measure of the force of gravitation on the object and it will be different in different gravitational situations.

The mass of an object is sometimes described as the amount of material that an object is composed of; it will be what it is, regardless of the gravitational system it happens to be in. For example, a rock has a mass of two kilograms. Its mass is two kilograms on earth, on the moon or in a space vehicle that is moving in a condition of weightlessness. The mass of an object does not change.

This distinction between weight and mass is important in the sciences particularly physics. However in the practical everyday uses that require weights or weighing we will be using grams and kilograms as units of weight. In metric countries throughout the world, fruit, vegetable, butter, meat, etc. are bought by the kilogram and gram in much the same way that we use pounds and ounces.

In the elementary grades we will not be concerned with the distinction between weight and mass.

Make comparisons of weight using a pan balance and small objects, such as dried peas, dried beans, discs, nails, pebbles, sugar cubes, paper clips, counting cubes, geometric blocks.

- Collect and record information such as:

  Which set of objects is heavier (lighter) 3 paper clips or 2 sugar cubes? Guess (estimate) first.

  How many sugar cubes balance a box of crayons?

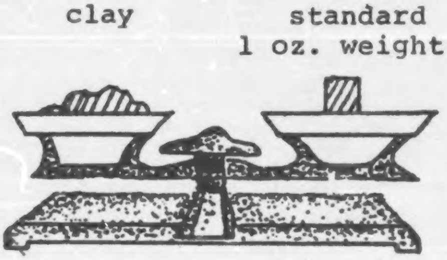
  How many peas balance 5 beans?

  How many different sets of blocks can you find that balance each other?

- Examine and discuss the data collected. Do you know how much any of these things weigh? What can be used to find the weight of an object?
- Introduce the standard unit of weight pound. Examine and "feel" assorted weights of 1 pound.
- Find objects in the classroom and guess whether they weigh 1 pound, less than 1 pound, or more than 1 pound.
- Check the estimates by balancing each object on a pan balance with a 1 pound weight.

Explore the relationship between ounce and pound.

- Use clay or plasticene to make as many 1 ounce weights as are needed to balance a one pound weight.



- Determine that 16 1 ounce weights balance or weigh as much as a 1 pound weight.

Use a balance scale, 1 ounce weights and an assortment of beads, marbles, sugar cubes or other similar objects.
Find out how many sugar cubes will balance (or weigh the same as) 1 ounce; 2 ounces; 3 ounces; and so on.

Make a table as shown.

How many in	1 oz.	2 oz.	3 oz.	4 oz.	8 oz.	1 lb.
Sugar cubes						
Paper clips						
Beans						
Marbles						

Use the standard units of weight, ounce and/or pound and scales to weigh 4 to 6 objects in the classroom. Guess the weight first then use scales to check. Record the results.

OBJECT	MY GUESS	WEIGHT
Ruler		
Eraser		
Book		
Stapler		
Block		

Rank the objects by weight from the heaviest to the lightest.

Collect pictures of things that are weighed in pounds.

METRIC SYSTEM

NOTE:

Introduce the metric units of weight, and kilogram in a very informal manner. At this time no attempt should be made to teach prefixes and to make conversions either within the metric system or in relation to the customary units. However, pupils and teachers could develop a feeling for comparison between units, e.g. a kilogram is heavier than a pound.

The following activities are designed to guide you and the pupils to
THINK METRIC.

Develop an awareness of metric units of weight using metric scales, gram and kilogram weights.

. Examine the different weights and "feel" the weight of 1 gram; 2 grams; 5 grams; 10 grams; 1 kilogram. Use the metric weights and a balance scale to find out how many grams balance a nickel, a pen, a box of gelatin, a box of cereal and other similar objects.

- Record the weight of the objects in grams.

Find some objects in the classroom and guess whether they weigh approximately 1 kilogram, less than a kilogram, or more than a kilogram. Check the estimates by balancing each object on a pan balance with a kilogram weight.

Make a chart of the results.

OBJECT	MY ESTIMATE	1 Kilogram	Heavier than 1 kilogram	Lighter than 1 kilogram
Scotch tape Dispenser	Less than 1 kilogram			X
Etc.				

NOTE:

Treat weight as a topic for ongoing study throughout the year.

*

UNIT 57. NUMBER-NUMERATION

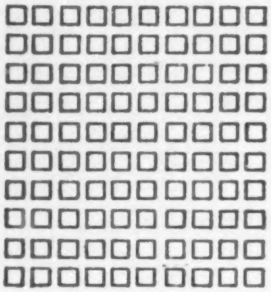
Use materials such as multibase blocks, tens-strips, hundred squares, interlocking cubes, centimeter graph paper to:

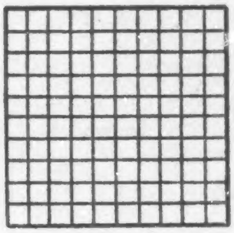
a. count by hundreds to 10 hundreds
b. count by hundreds and tens to 10 hundreds

Suggestions for Pupil Activities

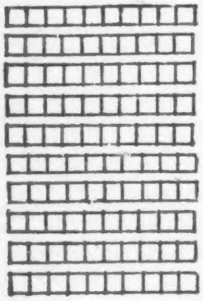
Investigate various ways of representing 1 hundred.

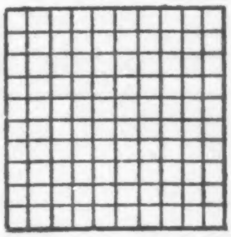
- 100 ones = 1 hundred square





- 10 ten-strips = 1 hundred square





Similarly, represent 2 hundred, 3 hundred, 4 hundred ... 10 hundred.

- Introduce the 3-digit numeral for 1 hundred - 100

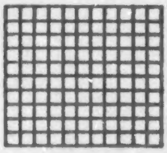
- Develop a variety of notations for multiples of 100 and discuss them in terms of different names for the same number. For example:

100 ones = 100
200 ones = 200
300 ones = 300
etc.

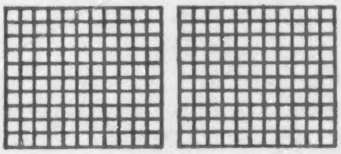
10 tens = 100
20 tens = 200
30 tens = 300
etc.

Organize sets of hundred squares to explore counting by hundreds to 10 hundreds.

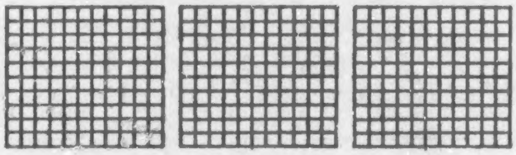
1 hundred
100



2 hundred
200



3 hundred
300
etc.



- Count sets of hundred squares as: 1 hundred, 2 hundred, 3 hundred and so on.

- Write the standard numeral 100 for 1 hundred, 200 for 2 hundred, 300 for 3 hundred, and so on, to 1000 for 10 hundred.

- Use the "graph" arrangement of the hundred squares to compare multiples of 100. Write mathematical sentences.

$200 < 300$ or $300 > 200$

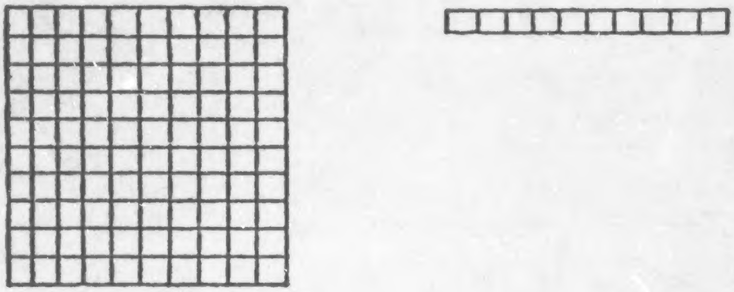
- Derive addition and subtraction sentences.

How much more is 300 than 200?
$300 = \underline{200 + 100}$

How much less is 200 than 300?
$200 = \underline{300 - 100}$

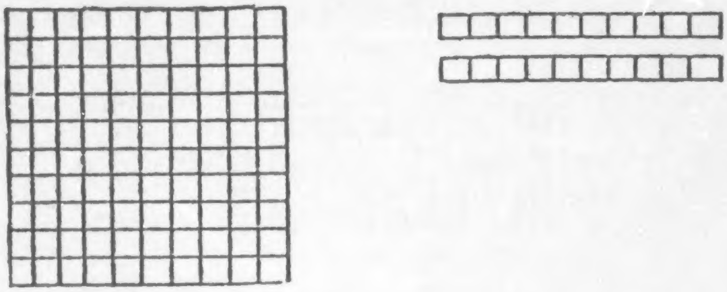
Organize sets of hundred squares and tens strips to demonstrate the sequence of numbers when counting by tens from 100.

Hundred squares   Tens strips



1 hundred ten

110

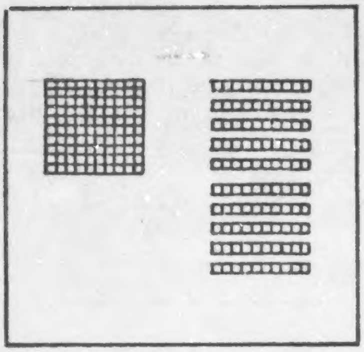


1 hundred twenty
120

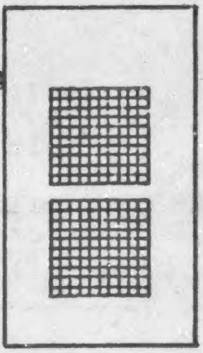
Similarly show 130, 140, 150, ... 190.

Teacher's Notes

- Demonstrate counting by tens from 190 to 200.



Exchange 10 ten-square strips for 1 hundred square strip.



1 hundred + 10 tens = 2 hundreds
200

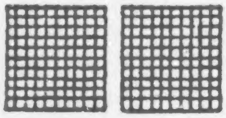
Discuss: Counting pattern - each succeeding number is 10 greater than the preceding number.
Standard 3-digit numeral for 1 hundred ten, 1 hundred twenty, etc.
Regrouping 10 tens as 1 hundred when going from:

190 to 200
290 to 300
390 to 400 etc.

Standard numeral for 10 hundreds (1000)

Use squared materials and place value charts to discuss the meaning of 3-digit numerals.

- Show 215.

Hundreds	Tens	Ones
 2	 1	 5

- Name the number represented as the number of hundreds, tens and ones (expanded notation).

  2 hundreds + 1 ten + 5 ones
  200 + 10 + 5 = 215

- Consider the numeral 215 and discuss the meaning of the digit 2 as 2 hundreds or 200; the digit 1 as 1 ten or 10 and the digit 5 as 5 ones or 5.

- Similarly show the place value meaning of other 3-digit numerals.

Teacher's Notes

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UNIT 58. PROBABILITY

Develop the awareness that some "chance" events **have an equal probability of happening.**

Suggestions for Pupil Activities

Make predictions about which card is likely to be drawn from a bag containing 7 cards, each naming a different day of the week. (Each card is put back in the bag before another card is drawn)

Ask: How many days are there in a week? (7)
How many day-cards are in the bag?
What's your favorite day?
What are the chances of picking your favorite day?
(1 out of 7)

Day	Tally
Sunday	
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	

Direct as follows:

- A pupil draws out a day-card, reads the day, puts a tally mark in the correct space on the tally chart, and returns the card to the bag.
- 6 other pupils do the same in turn.

Discuss the chart after 7 trials.
Were all of the days drawn?
Were some drawn more than once?
What do you think would happen if 7 more days were drawn?
(continue activity)

Play a guessing (prediction) game.

Select 3 children to go on errands out of the classroom. While they are out, have the rest of the pupils guess who will come back first. Record their guesses on the chalkboard.
Ask:

Who did most of the pupils think would be the first to return?
Who returned first?
If the same pupils were sent out again do you think it would be the same? Why?

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